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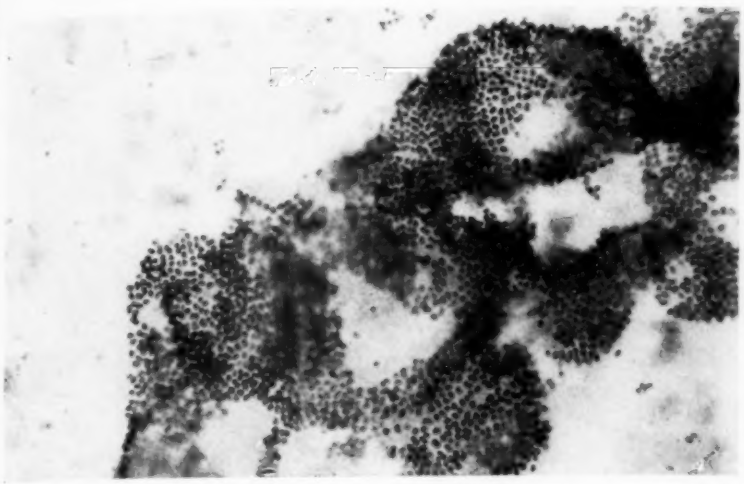


FIG. 1. CASE 33-24. AGE 25 YEARS. INTENSE GONORRHEAL CONJUNCTIVITIS 5 OR 6 DAYS FROM INFECTION. EPITHELIAL CELL SCRAPING FROM EPIBULBAR CONJUNCTIVA NEAR UPPER CULDESAC. DENSE TURF OF GONOCOCCI ON SEVERAL CONGLOMERATE CELLS; DENSEST AT CELL BORDERS. DRY FIXATION. LINDNER'S CONTRAST STAIN. 1000 X.

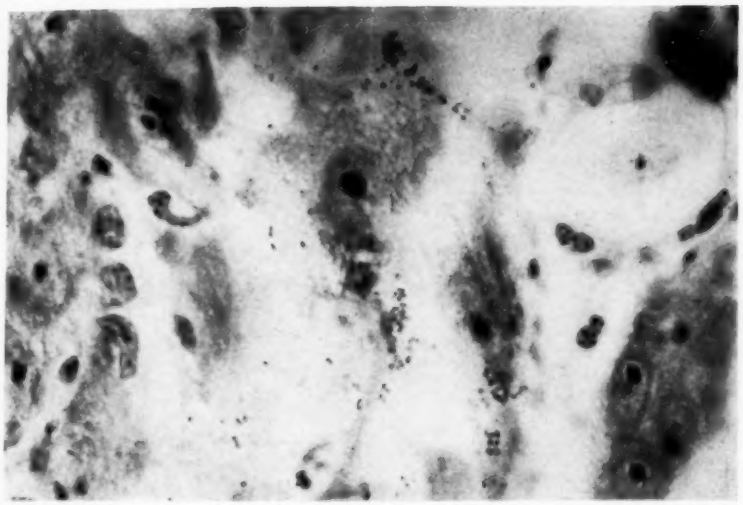


FIG. 2. GONORRHEAL OPHTHALMIA IN NEWBORN. SECTION OF TISSUE FROM PALPEBRAL CONJUNCTIVA NEAR UPPER CULDESAC. EDEMA OF ALL LAYERS. GONOCOCCI ON CELLS, CHIEFLY IN MIDDLE LAYERS. NOT YET PENETRATED TO DEEPER LAYERS WHICH CONSIST OF SMALLER COLUMNAR CELLS. WET FIXATION. GIEMSA STAIN. 1000 X.

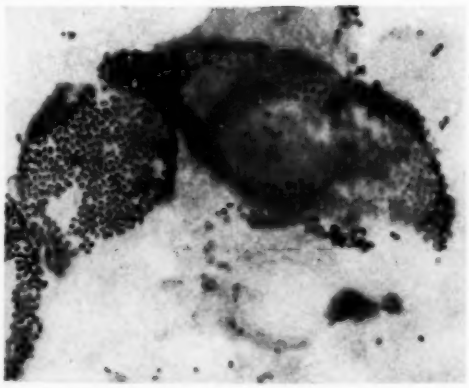


FIG. 3. SAME CASE. BULBAR CONJUNCTIVA. TURF OF GONOCOCCI ON ANTERIOR SURFACE OF EPITHELIAL CELLS. DRY FIXATION. CONTRAST STAIN. 1000 X.

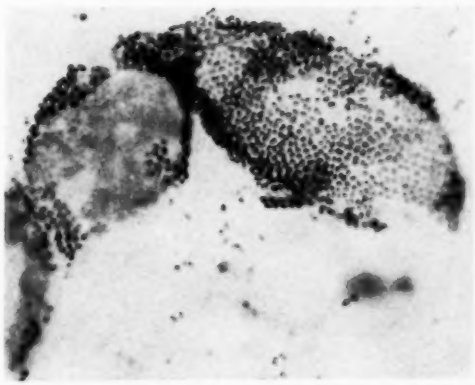
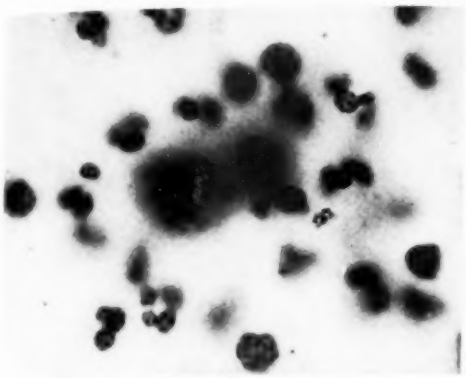
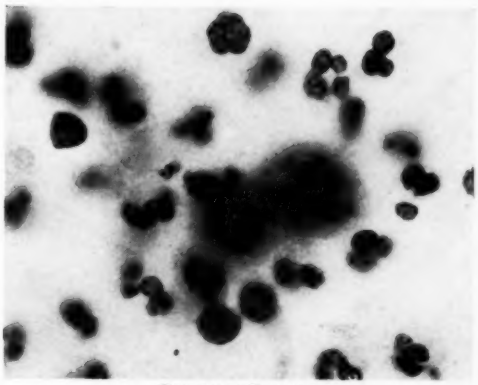


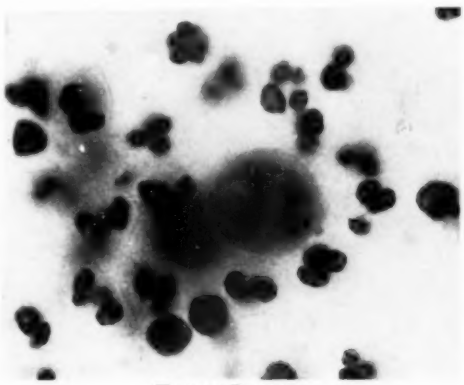
FIG. 4. SAME CASE. TURF OF GONOCOCCI ON POSTERIOR SURFACE OF SAME CELLS AS SHOWN IN FIG 2.



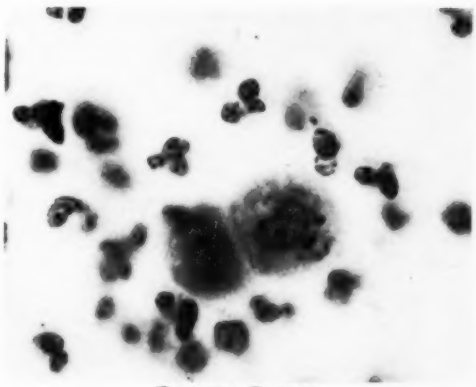
FIRST PLANE



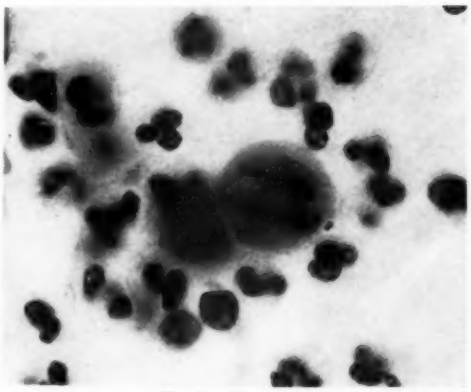
SECOND PLANE



THIRD PLANE



FOURTH PLANE



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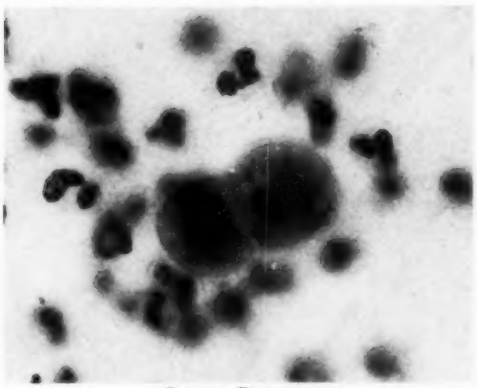

SIXTH PLANE

FIG. 5. CASE 29-24. GONORRHEAL CONJUNCTIVITIS IN NEWBORN. NINTH DAY. SCRAPINGS FROM PALPEBRAL CONJUNCTIVA OF UPPER FOLDS. EPITHELIAL CELL PHAGOCYTOSIS OF 25 TO 30 GONOCOCCI. PICTURES TAKEN IN DIFFERENT PLANES EACH SHOWS SOME GERMS NOT VISIBLE IN THE OTHERS. WET FIXATION. GIEMSA STAIN. 1000 X.

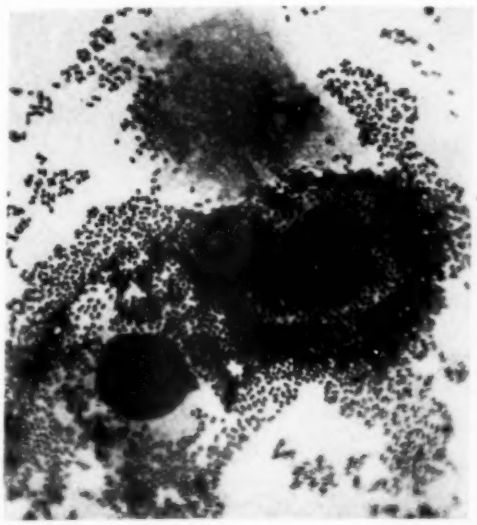

FIG. 6. CASE 59-24. AGE 2 YEARS. PNEUMOCOCCUS CONJUNCTIVITIS SECOND DAY AFTER INFECTION OBSERVED. CORNEA CLINICALLY NORMAL. SCRAPINGS OF EPITHELIAL CELLS FROM CORNEA ABOUT 2 OR 3 MM. INSIDE OF LIMBUS. DENSE GROWTH OF PNEUMOCOCCI ON THREE LARGE CELLS. DRY FIXATION. GIEMSA STAIN. 1000 X.

FIG. 7. CASE 61-24. AGE 3 YEARS. PNEUMOCOCCUS CONJUNCTIVITIS SECOND DAY AFTER INFECTION OBSERVED. CORNEA CLINICALLY ABSOLUTELY NORMAL. SCRAPINGS MADE FROM CENTER OF CORNEA. NO EPITHELIAL CELLS: ONLY DENSE MASSES OF PNEUMOCOCCI, SCRAPED OFF THE CORNEAL EPITHELIUM. DRY FIXATION. GIEMSA STAIN. 1000 X.

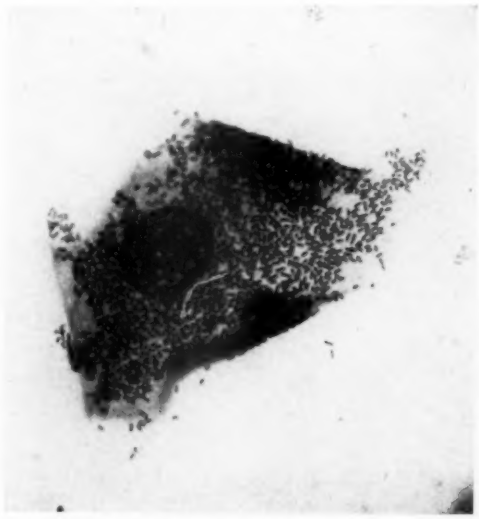

FIG. 8. KOCH-WEEKS' CONJUNCTIVITIS SECOND DAY. EPITHELIAL CELLS FROM BULBAR CONJUNCTIVA. CELL ALMOST COMPLETELY COVERED BY KOCH-WEEKS' BACILLI. DRY FIXATION. GIEMSA. 1000 X.

FIG. 9. KOCH-WEEKS' CONJUNCTIVITIS SECOND DAY. BULBAR CONJUNCTIVA. EPITHELIAL CELLS WITH TURFS OF KOCH-WEEKS' BACILLI, ALSO IN PROCESS OF PHAGOCYTOSIS. MANY BACILLI LIE AT DIFFERENT ANGLES TO THOSE ON THE SURFACE. DRY FIXATION. GIEMSA. 1000 X.

FIG. 10. LINDNER'S SPECIMEN OF DIPHTHERITIC CONJUNCTIVITIS. SCRAPINGS FROM PALPEBRAL CONJUNCTIVA BENEATH MEMBRANE. SPARSE GROWTH OF DIPHTHERIA BACILLI ON TWO EPITHELIAL CELLS. GIEMSA STAIN. 1000 X.

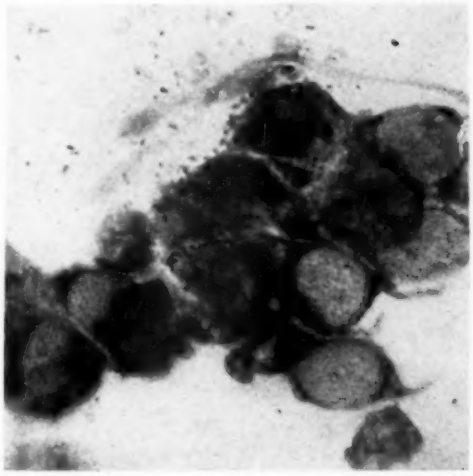

FIG. 11. LINDNER'S SPECIMEN OF INFLUENZA BACILLUS CONJUNCTIVITIS. SCRAPINGS FROM PALPEBRAL CONJUNCTIVA. SPARSE GROWTH ON SURFACE OF EPITHELIAL CELLS. CONTRAST STAIN. 1000 X.

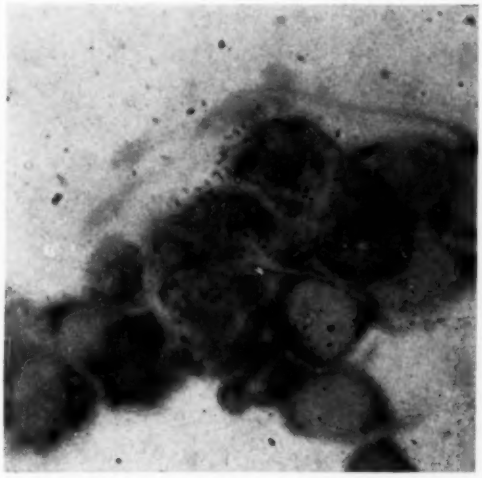

FIG. 12. SAME SPECIMEN AS FIG. 11. INFLUENZA BACILLI ON DEEPER SURFACE OF SAME CELLS. CONTRAST STAIN. 1000 X.

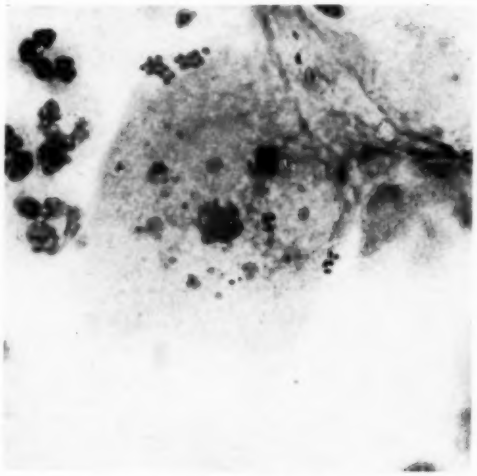

FIG. 13. CASE 63-24. 11 DAYS OLD. MIXED INFECTION. GONORRHEAL AND INCLUSION BLENNORRHEA. SCRAPING FROM UPPER CONJUNCTIVAL FOLDS. ONE LARGE FLAT EPITHELIAL CELL WITH MANY INCLUSIONS OF INITIAL BODIES. 3 SMALL AREAS OF GONOCOCCI. TURF LIKE ON SURFACE. DRY FIXATION. CONTRAST STAIN. 1000 X.

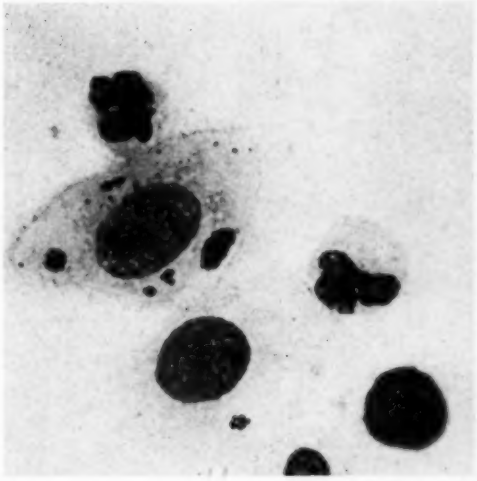

FIG. 14. CASE 74-24. 2 WEEKS OLD. INCLUSION BLENNORRHEA. SCRAPING FROM UPPER CONJUNCTIVAL FOLDS. TWO EPITHELIAL CELLS WITH INCLUSION OF INITIAL BODIES. WET FIXATION. GIEMSA STAIN. 1000 X.

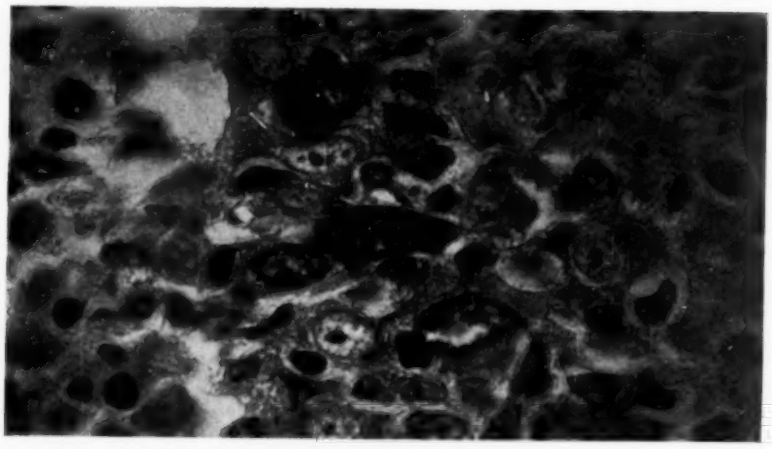

FIG. 15. TRACHOMA IN ADULT. SECTION FROM UPPER CONJUNCTIVAL FOLD. EPITHELIAL CELLS HAVE LARGE INCLUSION SPACES, WITH INITIAL BODIES MOSTLY AT PERIPHERY OF SPACE. WET FIXATION IN SUBLIMATE AND ALCOHOL SOLUTION. CONTRAST STAIN. 1000 X.

FIG. 16. 72-24. AGE 40 YEARS. CHRONIC ANGULAR CONJUNCTIVITIS. SCRAPINGS FROM TRANSITIONAL AREA AT EXTERNAL CANTHUS. DENSE GROWTH OF DIPLOBACILLI OF MORAX-AXENFELD, BUT ONLY ON DEAD EPITHELIAL CELLS AND DEBRIS. LOEFFLER'S METHYLENE BLUE STAIN. 1000 X.

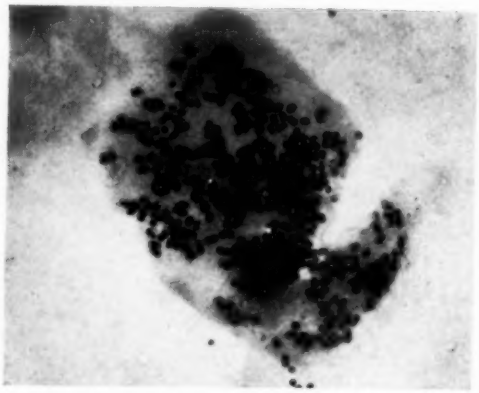

FIG. 17. STAPHYLOCOCCI GROWING AS SAPROPHYTES ON SURFACE OF A DEAD EPITHELIAL CELLS. GIEMSA STAIN. NO NUCLEUS VISIBLE. 1000 X.

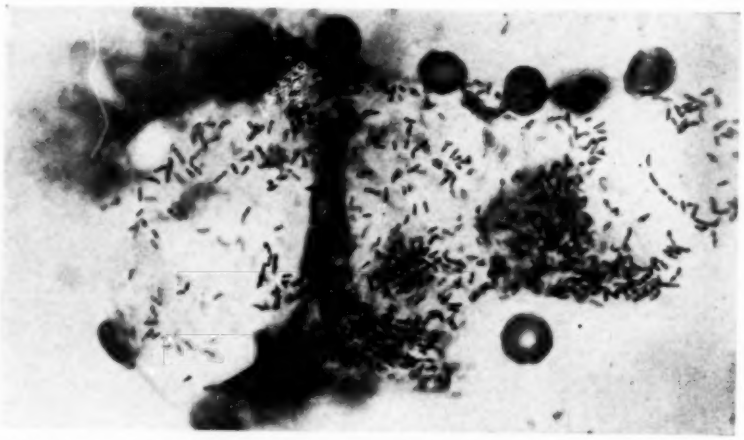

FIG. 18. CASE 62-24. SIX MONTHS OLD. EIGHT DAYS AFTER AN ACUTE CONJUNCTIVITIS. XEROSIS BACILLI GROWING AS SAPROPHYTES ON DEAD EPITHELIAL CELLS. GIEMSA STAIN. 1000 X.

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RÔLE OF THE EPITHELIAL CELL IN CONJUNCTIVAL AND CORNEAL INFECTIONS.

HARVEY J. HOWARD, M.D.

PEKING, CHINA.

This paper describes the technical methods devised and used by Lindner for study of parasitic microorganisms of the conjunctiva and cornea. Working in Lindner's laboratory the author confirmed his observations and supports his conclusions. The gonococcus, pneumococcus, Koch-Weeks' bacillus, diphtheria bacillus and influenza bacillus are parasites of epithelial cells, proliferating on the surface of the cell and drawing nutriment from it. As they penetrate the deeper layers, they provoke cell proliferation and other evidences of reaction. The older epithelial cells, each covered with a turf of bacteria, are cast off; and the younger cells become phagocytes which include and digest the bacteria, as Dr. Howard has demonstrated. This paper was presented at the meeting of the American Ophthalmological Society, June, 1924, but only a brief summary of it was then read.

The epidermis of the human body is a protective membrane of the deeper structures. Its superficial cells are no longer living, and therefore effect merely a mechanical protection. It has been known for years that the skin surface of the body harbors many bacteria, which grow in great abundance on the dead epithelial cells and exercise a non-pathogenic rôle. These bacteria are called saprophytes. Microorganisms that thrive only on living substances are referred to as parasites and, when associated with living cells of the body, exert a pathogenic rôle.

The mucous membranes of the human body differ from the epidermis in that their epithelial cell layers are much fewer, and are composed wholly of living cells, even in the most superficial layer. Of all the mucous membranes, the conjunctiva and the cornea most easily permit the carrying out of bacteriologic studies. Moreover, on account of their exposed position, these structures are subject to more or less frequent attacks from pathogenic microorganisms which produce purulent inflammation. The manner of growth and the topographic peculiarities of these microorganisms have not been known prior to certain discoveries recently made by Lindner, while he was engaged in the bacteriologic study of trachoma. These findings seemed to me to have opened the door for such important advances, not only in ophthalmology but also in all branches of medicine where the mucous membranes play a part, that I grasped the opportunity of devoting several months in Vienna to the investigation of the whole problem. It is a pleasant duty to record here my gratitude for the cordial assistance given me by Dr. Lindner who, at considerable inconvenience to himself, insisted upon my sharing his limited laboratory facilities.

In the main, I have confirmed all of Lindner's findings, and in addition have returned with the proof of epithelial cell phagocytosis, a process which Lindner had already observed and incidentally referred to, but the importance of which he admits he did not recognize. Furthermore it has been my good fortune to make certain new observations. It is my privilege today to lay before the members of this Society the results of my investigations, together with their interpretation and certain conclusions drawn therefrom.

METHODS AND TECHNIC EMPLOYED.

1. The cases examined were referred from Professor Dimmer's Clinic. They ranged in age from new-born children to old adults; in degree of pathologic change from the slightest evidence of irritation to the most severe purulent inflammation. In a few cases, infections in their earliest stages were observed and followed day by day thruout their course.

2. The eyes to be examined were rendered anesthetic by two instillations of cocain, the first a 5% and the second a 10% solution.

3. (a) A platinum spatula was used to secure scrapings from the palpebral conjunctiva. Spatulas of other metals when sterilized by flame heat are found to be covered with metallic precipitates which often alter the fixing and staining processes. In obtaining the specimen the spatula was held nearly at a right angle to the conjunctival surface and the scraping was secured by a quick firm movement. The same area was not scraped twice in succession because the presence of serum or blood in the specimen would, on account of its acid content, alter the staining reaction.

(b) A slightly dull discission knife with only one cutting edge was used to make the scrapings from the bulbar conjunctiva and cornea. One is surprised to find how difficult it is to secure material from these areas. It is practically impossible to secure cellular material from the normal bulbar conjunctiva and cornea, unless undue pressure is used.

4. (a) In many cases topographic scrapings of the conjunctiva were made as follows:

1. Upper palpebral; 2. Upper bulbar; 3. Lower bulbar; 4. Lower palpebral.

(b) In a few cases, when there appeared to be no danger in so doing, topographic scrapings from the cornea were made as follows:

1. From the center. 2. From an area included in a 2 or 3 mm. ring inside the limbus.

5. In many of the early cases examined, smears from the conjunctival secretion were made and stained with Loeffler's methylene blue.

6. *Dry Fixation.* All the cases were first examined with scrapings prepared by dry fixation. The scrapings were transferred immediately to thin cover glasses, allowed to dry in the air and then fixed on the glass by covering it with absolute alcohol. When the alcohol had thoroly evaporated and the material had again dried, the cover glass was placed, specimen side down, on the surface of the staining solution. Two staining solutions have been found to be the best for epithelial cell scrapings, viz: the standard Giemsa stain and Lindner's contrast Giemsa stain. For practical and diagnostic purposes, the latter is far the better because the nuclei of epithelial cells, lymphocytes and leucocytes do not take the blue stain while bacteria and inclusions do. By producing such a contrast, the germs are more readily found and their relationships to the cells are better distinguished. The contrast stain also has the advantage of being a more quickly acting stain than Giemsa's. On the other hand, specimens stained with Giemsa do not fade so quickly. Giemsa is better for specimens prepared by wet fixation.

(a) Giemsa stain: 10 cc. distilled water; 5 to 10 drops Giemsa solution.

Remove immediately the slight metallic skim with filter paper and thoroughly mix. Float the cover glass, specimen side down, on the surface of the staining solution and leave it there from 1 to 2 hours. Then dry the specimen, first with filter paper, then in air, and mount on a slide in pure cedar oil.

(b) Lindner's contrast stain:

10 cc. distilled water
5-10 drops Giemsa solution
1 drop concentrated alcoholic methylene blue solution
1 drop 1% acetic acid solution

Wipe away the metallic skim and mix. Leave specimen on the surface from ½ to 1 hour. Dry and mount in cedar oil.

7. *Wet Fixations.* The exact relationship of bacteria and inclusion bodies to the epithelial cells, as they exist in the living tissue, cannot be shown by specimens treated with the ordinary dry fixation method. Wet fixation must be employed, and one is surprised at the different picture he sees. The important thing in the technic of wet fixation is not to allow the specimen to dry in the least. Specimens should be transferred to the fixing fluid and from one solution to the next in an interval of only a second or two.

The scrapings are spread on a cover glass in the usual manner and the cover glass is quickly placed specimen side down into the following solutions. It is not necessary, or advisable to

place the cover glass on the top of the fluid as is done in dry fixation. The container, however, should be small and have a curved bottom so that the material on the cover glass does not come into contact with the glass at any point.

(a) 10 cc. concentrated sublimate solution.
20 cc. 95% alcohol.
Keep specimen in this mixture for ½ hour.
(b) Transfer to 30% alcohol, 2 hours.
(c) Transfer to 50% alcohol, 2 hours.
(d) Transfer to 70% alcohol, 12 to 24 hours or more.
(e) Transfer to 80% alcohol to which a few drops of Lugol's solution has been added, sufficient to give the solution a slight yellow color, 12 to 24 hours. (The Lugol's solution is added in order to remove the mercury in the fixing mixture.)
(f) Transfer to 95% alcohol, 12 to 24 hours or more (If more, change alcohol each day).
(g) Transfer to the Giemsa or to Lindner's contrast stain.
(h) Wash quickly with absolute alcohol.
(i) Wash quickly with xylol—not necessary to dry afterwards (only shake off excess xylol).
(j) Mount immediately on a slide, upon which a drop of cedar oil has been placed. (Canada balsam should not be used).
(k) Examine.

8. *Fixation of Sections.* It is important to know what takes place in the tissue as a whole. For this purpose a section of the affected conjunctiva must be examined. A small piece can be removed easily and without appreciable damage by squeezing down the opened blades of a pair of de Wecker scissors over a small area of conjunctiva and snipping off the tissue that lies between. The process of fixation and preparation of the specimen is somewhat long and tedious, but specimens prepared in this way are necessary in order to complete the picture. The technic is the following:

(a) Place the specimen at once in the following solution:
500 cc. distilled water
15 cc. concentrated sublimate solution
7 cc. concentrated acetic acid solution
Keep specimen in this solution for 2 hours, not more.
(b) Wash the specimen in tap water for 24 hours. This is done by putting the specimen in a wide-mouthed bottle, tying the mouth of the bottle securely with gauze and allowing the water to run directly into the bottle.
(c) 30% alcohol, 2 hours
(d) 70% alcohol, 2 or 3 days
(e) (1) 80% alcohol, 24 hours; (2) 80% alcohol + Lugol's solution, 24 hours
(f) 80% alcohol, 3 days (change alcohol each day)
(g) 95% alcohol, 2 hours
(h) Absolute alcohol, 2 hours
(i) Xylol-paraffin, 2 hours in incubator (temp. 37° C.)
(j) Pure paraffin, ½ hour in incubator.
(k) Pour the paraffin, together with the specimen, quickly into a dish containing cedar oil and put the dish in cold water but do not submerge it. The paraffin hardens almost immediately. The specimen within is then prepared for sectioning.
(l) Section the specimen. Sections must not be thicker than 4 mu.
(m) With a section on a slide, first wash with xylol and then immerse the slide in an upright position in a jar containing xylol for 10 minutes or more, in order to remove all the paraffin.
(n) Wash the specimen a moment or two with absolute alcohol, and then immerse in a jar of absolute alcohol for about 10 minutes.

(o) Wash the section in distilled water.

(p) Remove the section from the slide and stain as desired, either in Giemsa or Lindner's contrast stain. Since the technic is somewhat different from that used in the case of scraping, the method of each stain is given herewith in detail:

1. Giemsa stain method for sections:
   Leave the section in the Giemsa solution 3 to 5 hours. Then wash with absolute acetone which is free from water. Do not wash with absolute alcohol for it changes the Giemsa stain into one having a methylene blue reaction.
   Wash in xylol.
   Mount in cedar oil.
   Examine.
2. Lindner's contrast stain method for sections:
   Keep the specimen in the contrast stain 2 to 6 hours. Observe the staining process from time to time because the Giemsa stains available on the market do not act alike. It is generally better to overstain a little.
   Wash in ordinary tap water which is generally somewhat alkaline, in order to remove the excess of acid.
   Wash in absolute alcohol for ½ to 1 minute.
   Wash in xylol.
   Mount in cedar oil.
   Examine.

It has been impossible in the course of only a few months to collect data from a sufficient number of cases, studied from the very beginning to the end of each infection, to give a complete picture of what is produced by everyone of the known parasitic organisms. However, by using the data obtained from some cases examined at certain stages of infection and the data from other cases examined at other stages, I shall endeavor to present in chronologic order a composite picture of what does occur. This is done with the understanding that the data are not complete and that the gaps will have to be filled in by the results obtained from future investigations. It was my original intention to discuss in this paper only the parasitic microorganisms of the conjunctiva and cornea, but I have been forced to the conclusion that, for the purpose of proper classification and comparison, a discussion of the common saprophytes of the eye must be included, since in one instance at least a pathogenic rôle is played. This paper is based mostly upon the conjunctival findings, for the data regarding the cornea are still far from complete. The small amount of data that are already available will however be included. The descriptive data that concern each microorganism will first be presented separately. An interpretation of these findings and a discussion of the data as a whole will then follow.

1. PARASITIC MICROORGANISMS OF THE CONJUNCTIVA AND CORNEA.

A. *The Gonococcus.*

If microscopic examinations of smears from the conjunctival secretion are made immediately after a definite history of ocular inoculation with gonorrheal discharge, gonococci will generally be found. If repeated examinations of smears are made a few hours later, no gonococci will be found. Nor is there any clinical evidence of inflammation. At the end of about twenty four hours, one or more small areas of conjunctiva, most always in the bulbar region, are seen to be slightly inflamed, but still no gonococci will be found in smears from the secretion. If scrapings of the superficial epithelial cells are made from the area showing evidence of beginning inflammation and stained, preferably with Lindner's contrast stain, the surface of a few epithelial cells will be found partly covered with a turflike growth of gonococci. The microorganisms stand out intensely dark blue, against the background of faintly outlined protoplasm and nucleus, and lie on the surface of the cell in a single

stratum and uniformly adjacent to each other. Scrapings from noninflamed areas of conjunctiva do not show epithelial cells with a turf growth of germs, altho an individual cell here and there may show one or two isolated diplococci on its surface. As a matter of fact it is almost impossible to secure any epithelial material from a noninflamed area of conjunctiva or cornea, unless unusually heavy pressure of the scraping instrument be used.

At the end of 36 to 48 hours, the inflammatory areas of the conjunctiva are considerably increased in size. In fact, the whole bulbar conjunctiva may now be involved, there being a hyperemia of the subconjunctival vessels, some edema of the conjunctiva and generally a slight serous discharge. The palpebral conjunctiva, especially that of the culdesacs, is now likely to show evidence of inflammation. The results of the examination of topographic scrapings made at this time correspond exactly to the clinical picture, i.e., the most extensive turfs of gonococci are found where the inflammation is most severe, and those areas which are not inflamed show either no germs at all or only an isolated one here and there. Where the turf covers the surface of several adjacent cells, it is observed that the most intensive concentration of germs occurs at the cell boundaries, but no cells are seen with turf growths on both upper and lower surfaces. Up to this time, the growth of the diplococci is confined to the superficial surface of the epithelial cells where they seem to stick with great tenacity. Smears from the conjunctival secretion made at the end of 48 hours generally show a few gonococci, but no pus cells are seen or at the most only a very few. It is about this time, that is, the end of the second or the beginning of the third day, that the patient begins to notice the inflammation. By the end of the third or fourth day, there has developed a marked chemosis of the entire bulbar conjunctiva, numerous fine subconjunctival hemorrhages and some edema of the lids. The serous discharge is now profuse and contains some pus cells. Smears made from the secretion show gonococci in small numbers, but insignificant in proportion to the vast numbers seen at this stage in epithelial scrapings. Topographic examinations of the conjunctiva show extensive turf growths of germs, particularly on the large pavement epithelial cells of the bulbar conjunctiva (Fig. 1). The denser concentration of germs is more marked than ever at the cell borders.

A new phenomenon is now seen. Numbers of isolated cells, as well as some which are still partly attached to other cells, show growths of gonococci not only on one surface but, as the focus of the microscopic lens is changed, also on the marginal and the other flat surface of the cells. This means that the germs have finally penetrated the epithelial cover at the cellular interstices (Figs. 3 and 4).

From about the fifth up to the tenth day following the infection, in those cases not treated by milk injections, the intensity of the inflammation continues to increase. But the bacteriologic findings, which up to this time have corresponded to the clinical picture, from now on correspond to it less and less. It is no longer possible to see the subconjunctival hemorrhages which have undoubtedly greatly increased in size and number, because of the marked edema and leucocytic infiltration of the subconjunctival tissue superficial to the vessels. On the other hand, topographic examinations of scrapings made from areas equally inflamed show some conjunctival localities quite covered with gonococci and others entirely free. Furthermore, a change in the type of the superficial epithelial cells is observed, particularly from those areas which are found to be bacteriologically negative. Whereas in the beginning the superficial cells of the bulbar conjunctiva were large and flat, the cells are now seen to be much smaller and more cylindric in form, and with nuclei which stain more deeply with Giemsa. As already intimated above, no germs, or at most only a few isolated ones, are seen on these cells.

As long as the gonococci are con-

fined in their germinative proliferation to the surface of the conjunctiva, their manner of growth and the relationship between them and the epithelial cells are best revealed by scrapings prepared by dry fixation. But as soon as the germs have penetrated the epithelial cover, we must resort to the use of wet fixated scrapings and tissue specimens. It is possible only by examination of such preparations to get a true picture of the histologic changes that occur thruout the whole epithelial structure and to give a satisfactory explanation of the phenomena that takes place at different stages.

It was stated above, that on or about the third or fourth day of the disease the gonococci penetrate the superficial epithelial layer at cell borders, here and there, and begin to proliferate on the posterior surface of the superficial cells. As the intensity of the infection increases, the protoplasmic cement substance connecting the cells together and the superficial layer with the layers beneath dissolves. The dissolution of connecting substance continues to extend downward until all the layers of cells become more or less affected. As soon as the intercellular connections are broken, the exudate of serum and pus cells rapidly increases. In spite of this stream of fluid against which they must force their way, numbers of gonococci continue to grow inward (Fig. 2). But in rare instances only do gonococci penetrate as deeply as the subepithelial border. In all instances, the gonococci that penetrate the conjunctiva are firmly attached as parasites to the walls of their hosts, otherwise they would quickly be thrown back by the outpouring exudates.

By the end of a week or ten days, the intensity of the inflammation usually reaches its height. A histologic examination made during this period shows the epithelial layers to be in great disorder. Prior to this time there had already occurred, particularly in the bulbar regions, a lamellar separation of the superficial layer of cells from the layers beneath; but the large flat cells of that layer do not as a rule break apart from their neighbors. The layer comes off more often in patches consisting of many connecting cells. There now occurs an edematous separation of all the deeper layers and in many places a loosening of the cylindric or columnar cells from each other. In several cases the whole conjunctiva in certain areas becomes loosened from its base and is shortly thrown off, leaving behind here and there a few firmly attached basal cells which have been referred to as "epithelial pegs." From these pegs, a regeneration of cells begins. Following such a detachment, a whole new conjunctiva regenerates in less than 24 hours, and in 36 to 48 hours the conjunctiva is often found to be fully twice as thick as normal. This intense and rapid germination is seen best in specimens from the newborn, where one may occasionally see epithelial cells with as many as six or seven nuclei. These structures are in a true sense giant epithelial cells.

PHAGOCYTOSIS BY EPITHELIAL CELLS.

There is another phenomenon which is seen in wet fixated specimens from gonococcal infected cases. To me it is the most remarkable phenomenon of all those that are observed in conjunctival inflammations. This phenomenon is phagocytosis of gonococci by the epithelial cells of the conjunctiva (Plate XXIV). It begins by the end of the first week following the infection.

In the newborn its first appearance was noted on the ninth day, but the phagocytic process probably lasts much longer in the newborn than in adults. Since adults are now invariably given either an injection of milk or fresh typhoid vaccine immediately upon admission, their recovery is astonishingly rapid as compared with former cases not so treated. So if epithelial cell phagocytosis of gonococci is not observed in scrapings taken during the first 24 hours following such an injection, phagocytosis will not be seen in any subsequent specimens. Following a large milk injection, a complete exfoliation of all the conjunctival layers affected occurs generally in 12 hours; 24 hours later a full germinative renewal of cells takes place, and in two days the conjunctiva

may be twice as thick as normal due to a continued proliferation of cells. In one child epithelial phagocytosis was seen to be quite active until the twentieth day, altho much reduced over previous specimens in the relative number of cells involved. In another child the phagocytic activity of the epithelial cells was very marked even on the twenty-second day, but on the thirtieth day all evidence of such phagocytosis had disappeared.

Epithelial cell phagocytosis of gonococci was seen to occur in all layers of the conjunctiva, especially in the region of the culdesac, where normally there are only two or three layers. But phagocytosis in the bulbar region also occurs, for it is only in the beginning of the infection that one sees large pavement cells in the bulbar region. By the time that phagocytosis begins the entire bulbar and palpebral conjunctiva has already been renewed once and perhaps several times, so the cells that are now superficial in the bulbar area are not large and flat in character, but more like the normal columnar epithelial cells of the middle layers.

The number of gonococci that an epithelial cell may phagocytate varies greatly. It depends somewhat upon the cell and the stage of the disease. The most active phagocytosis of gonococci probably occurs on the average between the tenth and the fourteenth day. Some cells in my specimens contained only one or two gonococci, the majority included ten or twenty such bacteria, but in a few cells the number of ingested germs was so great that they flattened the nucleus against the cell wall merely by pressure. It is possible that the flattening of the nucleus was an artefact. One often sees in the same wet fixated specimen gonococci phagocytated by epithelial cells, in which the germs are in all stages of degeneration and digestion. Some cells are seen with small vacuoles around the germs the same as one occasionally sees in leucocytic phagocytosis. Some germs are seen which take the blue stain poorly, others almost not at all, still others which are mere shadows. Finally one occasionally sees cells in which the disintegration of bacteria is shown by the presence in the cytoplasm of little areas of cloudy looking granular material, which is the final stage of the germs before complete disappearance.

Mention has been made in several places about the presence of exudates of serum and pus cells during the course of the gonorrheal infection. The polymorphonuclear leucocytes evidently pass thru the conjunctival tissues rapidly, for in all wet fixated sections only a few such cells were found located within the conjunctival limits. In no case was a leucocyte found in the conjunctiva acting as a phagocyte of gonococci. Phagocytosis by leucocytes apparently occurs only in the secretion. That is, leucoycytes are effective only against germs which have been torn loose from their living hosts, the epithelial cells, and then become free in the conjunctival secretion. The first slight evidence of leucocytic phagocytosis of free gonococci occurs about the end of the first week. It then gradually increases up to the end of the second week and sometimes up to the third week. In children leucocytic phagocytosis sometimes persists until the end of the first month or longer. The presence of gonococci in the secretion means of course that germs are still growing as parasites somewhere on the epithelial cover. The entire conjunctival surface has probably been covered with gonococci during the course of the disease but certainly not all over at any one time. In most cases, after the end of the first week there is a marked diminution in the number of germs found growing turf like on the surface of the cells, i.e. at the time that marked proliferation of epithelial cells occurs, and when the old cells are sometimes thrown off in whole layers, leaving as the surface layer the columnar cells of the deeper layers which are better able to combat the invaders.

CHANGES IN THE CORNEA.

The description up to this point has been that of the picture produced in the bulbar and palpebral conjunctiva by the gonococcus. What occurs in the cornea? It is obvious that to make

scrapings from the cornea of patients suffering from a gonococcal infection entails dangers that are not justifiable unless the patient can be absolutely safeguarded. It was possible to make slight corneal scrapings in two cases which were under control by milk injections. One case was examined on the fifth or sixth day following infection. A very superficial scraping was made about 2 mm. from the limbus from a tiny area which clinically speaking was quite normal. The same turf formation of gonococci was found on several large flat corneal epithelial cells. The other case was examined twice, scrapings being removed from tiny areas of normal cornea about 2 or 3 mm. from the limbus. The specimen of the eighth day showed a considerable sized turf of gonococci on a number of cells. The specimen of the eleventh day showed only a few microorganisms attached to the cells.

In both specimens the density of growth was approximately one half of that found in conjunctival specimens removed at the same time. In addition to the cellular turfs, there were seen quite a number of free germs, which had evidently been scraped off from their hosts by the discission knife. In cases of gonorrheal ophthalmia complicated with ulcer of the cornea the gonococci are found growing on the surface of the corneal epithelium up to the margin of the ulcer. They are also found on the epithelial cells of the deeper layers when in the neighborhood of the ulcer the continuity of the layers has been destroyed, and the layers of cells themselves are split apart and are more or less disorganized. In the substance of the ulcer itself only a few free gonococci are found mingled with the detritus and exudate. There is no evidence that the gonococci proliferate in the substance underlying the ulcer itself.

B. The Pneumococcus.

It will not be necessary to describe in detail the picture produced by the pneumococcus and the other excitors of purulent inflammation of the conjunctiva, because the pathologic processes are all with one exception more or less alike. Their processes differ only in degree and duration. Reference and comparison will be made to bring out these differences.

Infections caused by pneumococci begin in the same way as those caused by gonococci. They generally proliferate first on the bulbar conjunctiva and then on the palpebral. But the multiplication and extension of the germs take place much more rapidly, and the pathologic picture accordingly changes more quickly. During the second day after the inflammatory symptoms have begun, the bacterial proliferation on the surface of the conjunctival epithelial cells reaches its maximum.

From a clinical viewpoint it is generally not possible to differentiate a pneumococcic infection from that caused by the Koch-Weeks' bacillus. There exists the same fine subconjunctival hemorrhages, altho perhaps not quite so extensive over the whole bulbar area in a pneumococcus conjunctivitis. The exudate of serum and pus cells begins earlier, but is not nearly so marked as in gonorrheal infections.

Penetration of pneumococci into the epithelial cover rarely occurs below the second or third layers of cells. Epithelial cell phagocytosis is seen very early. It occurs as a rule during the second day following the onset of symptoms, but is usually not so marked as that which occurs in conjunctivas infected by gonococci. Leucocytic phagocytosis of free pneumococci, which according to my observations begins chronologically after epithelial cell phagocytosis is already under way, is a very minor process.

Scrapings from the cornea, made during the second day, show an astounding number of pneumococci. Epithelial scrapings from near the periphery of the cornea generally include large flat epithelial cells, which show a very dense turf, but only on one surface (Fig. 6). Scrapings from the center of the cornea produce no cells, but such a mass of pneumococci that a view of the stained specimen under the microscope reminds one of culture growths (Fig. 7). While the

cornea is thus covered with germs, its clinical appearance is not abnormal, altho the patient sometimes complains of slightly diminished vision.

By the third day the scrapings are generally entirely negative, both from the conjunctiva and the cornea. Rarely is it possible to find any germs in the secretion at this time, altho a small number of free germs are to be found during the first and second days. In brief, the germs seemed to have disappeared as quickly as they came. But at this time the clinical appearance of the eye is much worse than it was during the second day, when the number of germs was at its maximum, i.e., the clinical picture no longer corresponds to the bacterial findings. In another day, however, the eye begins to show improvement and from then on the return to normal is rapid.

What has been described above does not apply wholly to newborn children. In them pneumococcic infections of conjunctiva are more persistent. In fact small turfs of germs may be found growing on living epithelial cells, for several weeks after the onset of the disease. In one case I observed such growths up to the forty-fifth day. Among six newborn cases the average was fifteen days, but the infection probably existed considerably longer, for three of the cases did not return after the first examination. Furthermore, phagocytosis by epithelial cells and leucocytes is much more marked in the newborn and continues almost to the end. A number of pneumococci may be found in the secretion at nearly every examination. But sometimes even when the epithelial scrapings are still strongly positive, the secretion may be negative.

Pneumococcic ulcers of the cornea only rarely begin with a pneumococcic conjunctivitis. But in ulcus serpens, pneumococci are also found in the substance beneath the ulcer itself.

C. The Koch-Weeks' Bacillus.

Infections of the conjunctiva produced by the Koch-Weeks' bacillus begin in the same manner as do infections caused by the gonococcus and the pneumococcus. The bacilli prefer the bulbar conjunctiva in the early stage and the palpebral conjunctiva in the later stage. In its clinical and pathologic aspects Koch-Weeks' conjunctivitis greatly resembles pneumococcic conjunctivitis. The infection reaches its crisis on the second day following the onset of symptoms. Fine subconjunctival hemorrhages involve almost the entire bulbar area. The exudation of serum and pus cells is only slight. The bacilli rarely penetrate deeper than the second epithelial layer.

Scrapings from the conjunctiva and cornea reveal an astounding growth of germs on the surface of the epithelial cells on the second day (Fig. 8). Generally by the third day the relative number of germs on these areas is much reduced, with the exception of the palpebral conjunctiva, where the germs are often more marked than they were on the previous day. Generally by the fourth day the scrapings are negative, altho from time to time during the following two or three weeks a few small turf growths may still be found in conjunctival scrapings. Epithelial cell phagocytosis of Koch-Weeks' bacilli usually takes place on the second and third days (Fig. 9). This process is far more marked than that seen in pneumococcic conjunctivitis. Leucocytic phagocytosis, if observed at all, occurs only as a very minor process in Koch-Weeks' conjunctivitis, in spite of the fact that large numbers of the bacilli may be found in the conjunctival secretion during the second and third days.

Ulcers of the cornea caused by the Koch-Weeks' bacillus do occur, but none was observed during the investigations conducted just prior to the preparation of this paper.

D. The Influenza Bacillus.

During my stay in Vienna no cases of influenza bacillus conjunctivitis, or of diphtheritic conjunctivitis came to the clinic, so I cannot report results on these infections from personal observations. However, I have examined Lindner's records, his specimens and his photographs and am convinced that these two microorganisms are also parasites of conjunctival epithelium.

In its growth as an epithelial parasite the influenza bacillus has a surface topography like that of the Koch-Weeks' bacillus, with which germ it is often confused. But in other respects it differs greatly from Koch-Weeks' infections. The proliferation of influenza bacilli on the epithelial cells and their penetration into the epithelial layers of the conjunctiva are only slight (Figs. 11 and 12). The clinical picture is quite in accord with these characteristics, for the inflammatory symptoms are never severe and there exists only a trace of pus in the secretion. But strange to relate, the secretion contains bacilli in abundance, as compared to the number found growing as epithelial parasites. Epithelial cell phagocytosis may occur but it has not been observed. Corneal examinations have not been made. In adults the germs may be found up to the end of the first week or so, but in children they are generally found much longer.

E. The Diphtheria Bacillus.

In diphtheria bacillus conjunctivitis the disease is complicated by, or rather associated with, a membrane which results from a coagulation of an exudate, that pours out thru the epithelial cells early in the infection, and which continues to pour out, more or less, thruout the disease.

Scrapings from the surface of the membrane and smears from the secretion reveal a large number of microorganisms, but they are found to be merely saprophytic germs of several varieties.

Histologic examination of sections of the membrane shows saprophytes on the superficial surface, but imbedded in the deeper portions diphtheria bacilli are usually found. If scrapings are made directly from the areas of the conjunctiva where the membrane has been lifted up and pulled back (but not torn away so that bleeding will occur), turf growth of diphtheria bacilli on flat epithelial cells and many free bacilli will be found. Later in the infection, when the growth of bacilli on the epithelial cells is diminished, the free germs are found to have been phagocytated by polymorphonuclear and mononuclear leucocytes. Epithelial cells from scrapings have been found with turfs of bacilli (Fig. 10) not only on their superficial surface, but also on their margins and under surface, showing that the bacilli have penetrated the epithelial cover; but it is doubtful whether they grow or penetrate below the second layer of cells.

Phagocytosis of diphtheria bacilli by epithelial cells has not been observed. Ulcer of the cornea rarely occurs in cases of diphtheria bacillus conjunctivitis. Fever is always associated with the ocular infection.

F. Inclusions of Trachoma and Inclusion Blennorrhea.

For reasons which will be fully explained below, the inclusion diseases of the eye are included among those associated with epithelial cell parasites of the conjunctiva.

In cases of acute trachoma and inclusion blennorrhea, small epithelial cell inclusions of initial bodies are first found about the end of the first week. Topographic scrapings reveal either inclusions or free initial bodies from almost every area of both the bulbar and palpebral conjunctiva. The secretion also contains free initial bodies. The inclusions increase in size and number and the number of free initial bodies increase generally until about the beginning of the third week when the clinical symptoms are usually at their worst. In many cases the clinical picture at this time, and in fact during all of the second week, is not unlike that of a gonococcal conjunctivitis. There is often considerable swelling of the lids, edema of the conjunctiva and a profuse purulent discharge. After the first two or three weeks inclusions are not often found in cells scraped from the bulbar conjunctiva. They seem to grow preferably and most abundantly in the epithelial cells of the upper conjunctival folds. I have examined, with negative results, scrapings from the cornea in a case of inclusion blennorrhea of the eighth and eleventh days respectively, in which numerous inclusions and free initial bodies were found on the same days from both the bulbar and palpebral conjunctiva. No epithelial cells were seen in which

initial bodies were growing on their surface, with the exception of a few cells which each had an isolated initial body or two sticking to it. Leucocytic phagocytosis of initial bodies is sometimes observed.

In inclusion blennorrhea, inclusions have been found as late as the third month. In chronic trachoma, inclusions are never numerous and are often found only with difficulty. Sometimes the first search for inclusions will reveal nothing, but if the scrapings have been properly secured the examination will eventually and almost invariably show inclusions. Unless one uses the contrast stain, the inclusions may easily be overlooked by the most experienced observer. With this stain the initial bodies stand out as dark blue, sharply outlined, coccilike bodies, in the faintly outlined protoplasm. Since the nuclei of the epithelial cells, lymphocytes and leucocytes are not stained blue by this method, the field can be searched more readily. Free initial bodies are, however, scarcely visible in contrast stained specimens, but are brought out clearly by Giemsa's stain. In the freshly stained specimen they are quite blue, but fade so quickly that even by the next day they have already lost much of their color. They are found in all stages of division and in a great variety of sizes. I have seen some as large as one third the size of red blood cells, but the great majority are smaller than the smallest cocci.

The inclusions of initial bodies vary greatly in size and numbers. The cells generally contain only one or two groups, but I have seen large cells with as many as 20 or 30 separate small groups of initial bodies. In many cells the most prominent inclusion is generally found adjacent to the nucleus, which it covers at one end, or on one side, like a cap. In more advanced stages cells are found, whose entire protoplasmic space appears to be filled with blue initial bodies. But some cells are seen whose inclusion bodies are partly blue and partly red, and others in which all the bodies are red and much smaller than the blue initial bodies. These are the elementary bodies. Once in a while specimens are found which clearly show the whole transition process from initial body to elementary body. Cells are found which show some initial bodies quite blue and others in various stages of fading. Those with no blue color at all, appear to have only a shadow of a coat or mantle, and in the center of each is seen a red point. Finally we see inclusion bodies where the mantles have entirely disappeared, leaving behind only the red points which are the elementary bodies. Sometimes the epithelial cell membrane is seen to be ruptured and numerous elementary bodies are observed in the act of being extruded into the secretion.

In dry fixated scrapings, which have been described above, the inclusion bodies are almost invariably massed close together, so that it is often difficult to consider them as individual entities. The picture as revealed by wet fixation of scrapings is quite different. In such specimens the initial bodies are generally discrete, separate and distinct and oftentimes many of them look like diplococci (Fig. 14). In wet fixated scrapings another marked difference is observed. The inclusion space in cells with large inclusions appears filled with a translucent fluid thru which the initial bodies are distinctly seen. These bodies are located almost entirely at the periphery of the space, evidently feeding upon the cytoplasm. In wet fixated cells, which contain inclusions consisting of both initial and elementary bodies, the latter are observed lying deeply within the inclusion cavity, while the initial bodies are generally found attached to the living cytoplasm at the periphery of the inclusion space. This close relationship of the initial bodies to the periphery of the cavity is seen even better in wet fixated sections of the conjunctiva, as illustrated in several cells of Fig. 15.

Morphologically the initial bodies, in their various forms, and the elementary bodies are identical in inclusion blennorrhea and trachoma, acute and chronic. I have observed a mixed infection of gonococci and inclusions in only one proved case. The inflamma-

tory symptoms began on the third day after birth. I first saw the baby on the eighth day. Gonococci were found in turf formation on epithelial cells from the bulbar and palpebral conjunctiva, and from the cornea in large numbers. There were also many free gonococci. Epithelial cells with small initial body inclusions were found in all of the conjunctival specimens, but none in the corneal specimens. Free initial bodies were also present, but most interesting of all was the finding of several epithelial cells which contained both inclusions in their protoplasm and small turfs of gonococci on their surface. This is illustrated in Fig. 13, which shows a large epithelial cell with many inclusions within the cell and three small turfs of gonococci on its surface. Phagocytosis of gonococci by a few epithelial cells was observed, but none was found which contained both gonococci and inclusion bodies. This case was followed every day for a week, when the mother took the baby home. At each successive examination the number of gonococci found were less and the inclusions more numerous and larger. The child was being treated with silver nitrat solution.

G. Inclusions in Vernal Catarrh.

The opportunity was afforded for examining two cases of vernal catarrh; one was purely the pericorneal type, the other was a typical catarrh of the palpebral conjunctiva. In the first case, a woman of 32 years of age who complained of having had the disease for fifteen months, no inclusions were found, altho a thoro search was made thru several cover glass scrapings—a task which took several hours.

In the second case, a girl of twelve with a history of first symptoms dating back six years, there existed a typical flat paving stone like involvement of the palpebral conjunctiva only. There was absolutely no evidence of trachoma, which in any case would have been most unusual, because the case was seen in Zurich where trachoma is practically unknown. Scrapings from both upper and lower palpebral conjunctiva were made. A search occupying several hours was rewarded by the finding of two cells, one of which contained a very small inclusion in its protoplasm, and the other which contained two small inclusions. The inclusion bodies of both cells were morphologically like the initial bodies of trachoma. No elementary bodies were found, nor were any free initial bodies recognized. The case was undoubtedly one of vernal catarrh because all the specimens contained many leucocytes which were almost without exception of the eosinophilic variety.

II. THE SAPROPHYTIC MICROORGANISMS OF THE CONJUNCTIVA.

A. The Diplobacillus of Morax-Axenfeld.

A large number of cases of angular conjunctivitis were examined. In none of them was the diplobacillus found growing on living epithelial cells of the conjunctiva or cornea. However, topographic scrapings of the conjunctiva revealed in many cases a few free bacilli and turf growths of diplobacilli, on isolated dead epithelial cells or debris, which happened at the time the scraping was made, to be sticking to the living epithelial cover. The secretion sometimes contained diplobacilli, sometimes none. But scrapings made from the wet oily looking skin surface in the region of the external canthus (and sometimes of the internal canthus) always revealed numerous diplobacilli, many of them growing turf like on dead epidermal cells, or lying free in the specimen (Fig. 16). In most cases, scrapings from the marginal or transitional zone of the lid margins procured dead epidermal or conjunctival cells with diplobacilli on them. In one case there was considerable conjunctival inflammation with a mucopurulent discharge but no other germs were found than the diplobacilli, and these only upon dead cells and debris mostly on the skin surface adjacent to the canthus. Diplobacilli of Morax-Axenfeld were also found in small numbers in the conjunctival secretion and on the lid margins of a number of cases that had no signs of conjunctival irritation at all.

B. Xerosis Bacillus, Staphylococcus and Pneumococcus.

Xerosis bacilli were frequently found in cases in which I had previ-

ously found parasitic germs and where the inflammatory symptoms were subsiding, but in no case were xerosis bacilli found growing on living epithelial cells. They were found either free in small numbers in the secretion or growing on debris or dead epithelial cells which had been cast off by the conjunctiva and cornea (Fig. 18). After an acute pneumococcus conjunctivitis, I have found dead epithelial cells covered over with a growth of xerosis bacilli without any evidence of irritation resulting from their presence.

Staphylococci, also, do not grow on living epithelial cells of the conjunctiva and cornea. They are often found growing in a prolific manner on dead epidermal cells, even up to the transitional cells of the conjunctiva, and also on dead cells cast off from the conjunctiva or cornea (Fig. 17). But up to the present time I have not seen inflammation or irritation of the conjunctiva, that I felt convinced was due to their presence.

The pneumococcus is not only a parasitic germ of the conjunctiva and cornea, but it is more often found as a saprophyte growing on shreds of mucus in the conjunctival secretion; and even more frequently on dead cells in the region of the bulbar conjunctiva which have not been effectively cast off and carried away by the action of the lid movements and the lacrimal secretion. These germs grow turflike on such dead cells without producing any ocular symptoms.

There are other saprophytic microorganisms, which one may find growing together with those mentioned above, in prolific manner on the surface of membranes in diphtheritic conjunctivitis and also on the surface of the conjunctiva and cornea in cases of xerophthalmia and keratomalacia. The identity of these other germs has not been established.

DISCUSSION.

We are primarily interested in the excitors of purulent inflammation of the conjunctiva. These are often referred to as parasitic microorganisms. We want to determine if it is possible to recognize a parasitic microorganism by its manner of growth and by any peculiar relationship it may have to the conjunctiva during the period of that growth. We want to be able to state that all microorganisms which do not possess such characteristics in some degree at least, cannot be classed as parasites. Also what rôle is played by bacteria which cannot be classed as parasites? And finally how do the excitors of purulent inflammation act upon the cornea and the cornea upon them? In order to arrive at the decisions sought, the discussion of the preceding clinical and bacteriologic data will be confined under the headings of (1) the parasitic microorganisms of the epithelial cover of the eye, and (2) the saprophytic microorganisms.

1. THE PARASITIC MICROORGANISMS OF THE EPITHELIAL COVER OF THE EYE.

A. The Bacteria.

Based upon the data that has been given in the descriptive section, it is possible to suggest the manner in which an infection of the conjunctiva begins. The primary infecting microorganism settles somewhere upon the surface of the normal conjunctiva and in the course of a few hours, by multiplication, forms a small turf like growth of germs around the original germ. These germs grow and multiply by feeding upon the substance of the living epithelial cells. Furthermore, they proliferate in a single layer so each germ is attached to the surface of a living epithelial cell. These germs are therefore parasites of the epithelial cells which act as the hosts. During the course of the bacterial proliferation a germ now and then becomes loosened from its host by the movements and the pressure of the eyelids and, settling upon a more or less distant spot of the conjunctiva, becomes the focus of a new infection and of another germinative proliferation. Here then we have, as Lindner has expressed it, a real example of focal infection.

Some bacteria proliferate with astounding rapidity, others more slowly. The period of incubation, or rather the beginning of the inflammatory symptoms, is dependant upon the rate and the extension of the proliferation of bacteria on the surface of the epithelial cover. For example, infections caused

by the pneumococcus or the Koch-Weeks' bacillus generally produce symptoms by the second day following the primary inoculation, while a gonococcal infection of the conjunctiva is not usually observed until the third day. In the case of all three of these microorganisms the proliferation generally begins on the bulbar conjunctiva and extends rapidly, thru the creation of many separate foci, over the whole bulbar conjunctiva, and also over part, or very probably over the whole of the cornea too. The proliferation then extends more slowly over the palpebral conjunctiva.

In some cases this preference of the bacteria first for the bulbar conjunctiva and the cornea and then for the palpebral area is not so noticeable, but in the majority of cases the relative topographic distribution occurs in this manner and sequence. The number of bacteria growing on the palpebral conjunctiva never seems to be as great as those found on the bulbar conjunctiva and cornea. But the bacteria disappear from the latter areas almost as suddenly as they originally appear, i.e., by crisis, whereas bacteria may be found growing like a turf on the surface of palpebral cells here and there for a much longer time. They seem to disappear from palpebral areas rather by lysis. In pneumococcus and Koch-Weeks' conjunctivitis the germs almost always disappear entirely by the third or fourth day, but in gonococcal infections the germs may be found for two weeks or more. In newborn children who become infected the bacteria persist much longer. For instance, the pneumococcus is sometimes found as a parasite for a month and the gonococcus for two or three months, even in treated cases.

In conjunctivitis caused by the influenza bacillus the growth of bacilli on the surface of the epithelial cells takes place, but only in a slight degree as compared to the growth of the germs already mentioned. Furthermore the clinical picture agrees fully with the bacterial findings, i.e., the inflammation is also slight in degree.

In diphtheria bacillus conjunctivitis the bacilli also grow as parasites on the conjunctival epithelium, but the formation of a membrane makes it more diffcult to study the germ in its relation to the conjunctiva. The bacilli are found growing on the surface of the epithelial cells beneath the membrane which must be lifted up in order to make a scraping.

The knowledge that bacteria grow on the surface of epithelial cells is not new. In the literature I have found three pictures of epithelial cells showing a few gonococci growing turf like on one surface. In all of his German editions Fuchs[5] has shown such a cell, but has made no reference to it in the text. Botteri[4], in an article published in 1912, also has an illustration and Lipschuetz[5], in his section in Kolle-Wassermann, likewise shows such a cell from the male urethra with gonococci on it. In 1912, Hanford Mckee[6] advocated the use of epithelial cells rather than the discharge in examining for gonococci. In fact the latter two are the only references I have been able to find in which there is more than a bare pictorial suggestion that the gonococcus is a parasite of the surface substance of cells of mucous membranes.

The importance of this phenomenon seems to have been overlooked until Lindner published his first observations in 1919[1] and then again in 1921[2]. The most astonishing thing about it is the fact that it has gone unheeded even since then, there not being a single reference in the literature to Lindner's finding, except an abstract or two (an article by Pillat[7], one of Lindner's younger colleagues, on the "Conjunctival Saprophytes" is an exception). I can only explain the disregard of this very important phenomenon by the fact, that we have all been too prejudiced by education and habit in making our diagnoses of mucous membrane infections in any other way than by examination of smears taken from the secretion and of cultures made from such smears.

The disappearance of germs from the surface of any area of the conjunctiva seems to be closely associated with the breaking of the epithelial cover at that place. What causes these breaks? By the process of exclusion it must be the ectotoxins of the bac-

teria that are growing on the surface of the living cells. There are no dead bacteria present at this stage, so the cause certainly cannot be endotoxins. The ectotoxins generated by the ever increasing numbers of bacteria diffuse directly into the conjunctival structure beneath them and produce there a dissolution of the protoplasmic cement substance connecting the cells and thereupon breaks in the superficial epithelial layer occur. As soon as breaks in the superficial layer take place, the proliferation of bacteria, which is generally more pronounced at the cell borders (due apparently to the better nutrition afforded there), extends thru the openings produced and grows on the borders and on the posterior surface of these superficial cells, which have already become a little loosened from the layer beneath. From the advancing growth of germs ectotoxins are continuously released which diffuse farther and farther into the conjunctiva. The dissolution of cement substance due to these toxins continues to extend until all the layers become more or less affected. But along with this dissolution of intercellular and interlamellar cement substance there is another process taking place simultaneously. As soon as the toxins diffuse into the conjunctival tissue they begin to stimulate an abnormal proliferation of the deeper epithelial cells. The more virulent the toxins the greater and the more rapid is the cellular proliferation, which is proved by the finding of cells with several nuclei. As many as seven nuclei have been seen in one cell. This wild proliferation of cells throws the conjunctival layers into great disorder.

The ectotoxins also have another effect. They produce a subconjunctival hyperemia and edema; and, as soon as the cement substance of the epithelial cells starts to break down, serum begins to come out thru the conjunctiva. The more extensive the dissolution of the individual cells and the layers from each other, the more profuse becomes the exudate of serum which soon contains pus cells in increasing numbers. Along with the outpouring of exudate there occurs an edema of the conjunctiva itself which increases the separation of cells and layers from each other.

Early in the process of proliferation of the deeper epithelial cells and the outpouring of exudate, the superficial epithelial cells are entirely cast off and deeper cells take their place. Generally the cells do not come off one by one but rather in small patches. In any case, the superficial cells with their dense turf soon disappear, and the cells that take their place may have a slight turf on them or have none at all. As the proliferation of cells continues, layer after layer is cast off, until the conjunctiva is composed of entirely new cells in a very few days. In some cases the proliferation of new layers takes place more rapidly than does the process of exfoliation, so that within the course of a few days the conjunctiva may be twice as thick as normal, especially in the region of the upper folds where originally there were only two or three layers of cells. Lindner believes that it is not the inflammatory edema so much as the wild proliferation of the deeper epithelial cells which produces this disruptive condition of the conjunctiva and the throwing off of layer after layer together with their parasitic bacteria.

In the case of diphtheria bacillus conjunctivitis, the presence of a tough tightly adherent membrane prevents the escape of toxins into the secretion. The toxins that are liberated are forced into the epithelial substance of the conjunctiva and from there penetrating into the subconjunctival tissue are absorbed by the lymph and blood and produce a severer systemic reaction than do other bacteria. For instance, high fever is always associated with true diphtheritic conjunctivitis. Furthermore the membrane does not permit the effective throwing off of the superficial conjunctival layers, on which the bacilli are growing, so eventually many germs which have consumed all of the available nutrient material, or which have been loosened from their host, not being able to escape, die in situ, and produce by that act certain endotoxins. So in this infection alone it is quite likely that both ecto- and endotoxins play a part. In spite of all the reaction the diphtheria

bacilli do not penetrate deeply into the epithelial cover, but always remain quite superficial.

In the case of the gonococcus the germs sometimes penetrate as deeply as the subepithelial tissue, but certainly only in very rare instances. The Koch-Weeks' bacilli and the pneumococci are seldom found below the second layer of cells. This halting in the course of the penetration of microorganisms into the epithelial layers is due to several things; first, the early casting off of the superficial layer with its dense turf of bacteria; second, the outpouring of exudates against whose current the germs must grow and penetrate; third, an extensive and increasing proliferation of the deeper epithelial cells which results in a continuous process of exfoliation of cells as layer by layer they become superficial. A fourth cause is a process which will now be discussed.

PHAGOCYTOSIS.

As soon as the bacteria have penetrated as deeply as the second or third layers, by which time active proliferation of the deeper cells is taking place thru the stimulation of the ectotoxins, the bacteria are confronted by a new form of resistance. They become phagocytated by the epithelial cells. This process begins at about the height of the clinical symptoms. In gonorrheal conjunctivitis it is first observed by the end of the first week, and then for several days its activity is seen to increase. The process lasts for at least a week in adult cases and for two or three weeks in new-born children. In pneumococcus and in Koch-Weeks' conjunctivitis, it begins about the second or third day and lasts only for about twenty-four hours; since by that time the germs have disappeared completely thru the effect of the combined resistance against them. In newborn children, in whom the power of resistance appears to be less, the germs are most always found much longer. In them epithelial cell phagocytosis naturally lasts much longer, and is also a much more active process. In gonococcus and pneumococcus cases the importance and degree of activity of the process seem to be in direct relation to the length of the disease. In Koch-Weeks' conjunctivitis it is a remarkably active process while it lasts.

Epithelial cell phagocytosis is best observed in wet fixated specimens, where the cells retain to a large degree their normal living form; i.e., they are not dried out, collapsed and flattened as are those in dry fixated specimens. Even in dried specimens one often suspects that bacteria are located within certain cells rather than on their surface. In the case of Koch-Weeks' bacilli one is quite sure of it, because the bacilli lie at all angles to the focal plane, whereas in cells where they are located only on the surface they all lie parallel to the plane of the principal focus. In dry fixated specimens it is possible merely by a slight turn of the micrometer screw to demonstrate turfs of germs, first on one surface and then on the other surface. But in the wet fixated specimens one can also, by turning the micrometer screw of the microscope, bring into view six to eight successive planes thru the cell in which different germs are brought into focus with each slight turn. Plate XXIV shows six planes thru one rather small epithelial cell which has phagocytated 25 to 30 gonococci.

Epithelial cells of the conjunctiva not only phagocytate bacteria but they apparently begin immediately to digest them in the same manner as do leucocytes. In most cases, particularly in pneumococcus or Koch-Weeks' conjunctivitis, the throwing off of cells in whole layers is so rapid, and regeneration of cells and new layers so complete, that one rarely sees the phagocytated germs in a dying or partially digested state. But I have seen it many times in gonococcic and pneumococcic cases and fully believe that digestion of Koch-Weeks' bacilli also occurs; and that it will be seen if the specimens are procured at the right time. One of the first evidences of digestive activity that I have observed was in epithelial cells containing gonococci. There was a distinct vacuole, or clear fluid space, around each diplococcus. This vacuolization was seen in only a few cells. Then follow all stages of degeneration from slight loss of blue color, then complete loss

of color when they appear like tiny cysts or mere shadows, to the final stage in which the germs are reduced to little smudgy spots in the cytoplasm prior to their complete disappearance.

In one case I saw so many gonococci massed within a few cells that the nuclei were flattened against the cell walls, giving the impression that the germs had multiplied within the cells. Such a process may be possible but in my opinion it is very improbable. In fact, I have no positive evidence that epithelial intracellular multiplication of bacteria takes place. If it occurs, it certainly does not take place within the cell in such a prolific manner as it does on the surface of the cell. In other words the germ plays the role of parasite when it is located on the cell's surface and appears to thrive abundantly, but when it becomes ingested the tables are turned and the epithelial cell becomes the parasite. The germ is quickly killed and becomes digested apparently without affecting the epithelial cell in any way. As far as I have been able to determine the cells are not killed during the phagocytating and digesting processes. At least no dead epithelial cells containing germs were found. Whether such cells eventually die from the effect of their successful efforts in digestion it is impossible to state; since all these cells are included amongst those which, in the regular course of the fight against the invading germs, soon become cast off from the conjunctiva.

What part does epithelial cell phagocytosis play in the fight against bacterial invaders of the conjunctiva? From my observations I feel convinced that by such phagocytosis the epithelial cells play an active part as soon as the germs reach the second or third layers of epithelium, and that their activity in this peculiar manner increases or decreases as necessity demands.

If we leave out for the moment that somewhat intangible thing called acquired immunity, phagocytosis of bacteria by epithelial cells may be looked upon as the last line of defense in the fight of the conjunctiva against the invaders. In my opinion it continues to act until the germs that have penetrated the conjunctiva have either been thrown off with the cells upon which they are growing, or until those that remain have all been phagocytated. I have not yet observed phagocytosis of influenza bacilli, or of diphtheria bacilli, by epithelial cells of the conjunctiva. I see no adequate reason why they should not be phagocytated. In diphtheritic conjunctivitis the membrane prevents investigations being carried on in a satisfactory manner. But in the case of the influenza bacillus, the infection produced is generally so slight, it is unlikely that breaks in the epithelial cover always take place, and such breaks or openings are of course necessary if the germs are to penetrate the conjunctival tissue and come into contact with the more viable cells of the deeper layers. That is, I do not believe that phagocytosis of any parasitic bacterium by the primarily involved superficial cells takes place. Later in the disease, when by exfoliation of superficial layers and by rapid proliferation of the deeper cells the superficial layers become composed of more viable cells similar to those of the original deeper layers, it is probable that such superficial cells do participate in the process of phagocytosis. I believe they do, particularly those in the region of the upper palpebral folds.

It was Metschnikoff[8] who first proved the existence of phagocytosis. He classified phagocytes into the "mobile" and the "fixed." In the group of mobile phagocytes he placed leucocytes, lymphocytes and other cells existing in the blood. The fixed phagocytes were certain connective tissue cells and endothelial cells. His classification has been accepted with only minor changes by bacteriologists down to this day. I have been unable to find in any textbook of bacteriology even of the latest editions any suggestion that epithelial cell phagocytosis is even suspected in the higher mammals. A statement by Hiss and Zinsser[9] sums up the general opinion regarding the phagocytic process in these words: "In the higher animals and man this function of phagocytosis is limited to the white blood cells of

the circulation, or leucocytes, to certain large endothelial cells lining the serous cavities and blood vessels, and to cells of a rather obscure origin which contribute to the formation of giant cells within the tissues." It is therefore revolutionary, I must confess, now to come forward with the assertion that the classification of phagocytes made by Metschnikoff and his followers is not complete and that phagocytosis by ectodermal cells also occurs in the body as a regular process, not as an isolated phenomenon. Furthermore, if phagocytosis of parasitic microorganisms by epithelial cells occurs as a regular process in inflammations of the conjunctiva, then why should it not also occur regularly in all of the other mucous membranes of the body both in higher animals and man? It is my conviction that it does take place, at least in some of the other mucous membranes. Epithelial cell phagocytosis has been observed by others before this, e.g., McKee[6] of Montreal and Lindner[2] of Vienna, but mention of the process in their articles is only incidental.

The suggestion may also be made that the turf like growth of bacteria, observed on the surface of living epithelial cells of the conjunctiva and cornea, is probably not unlike the growth of the germs of parasitic nature that should also be found proliferating on the surface of the cells of other mucous membranes.

But what about leucocytic phagocytosis? The consensus of opinion regarding the function of leucocytes is expressed by Jordan[10] in his 1922 edition of "General Bacteriology" in these words: "It was Metschnikoff who definitely established the phagocytic action of certain white blood corpuscles in combating bacterial invasion.—In general the degree of resistance shown by the organism is measured by the intensity of the local inflammatory reaction. Perhaps the most characteristic feature of the local reaction, or inflammation, is the gathering of the leucocytes at the affected point; and this has been shown by Metschnikoff to rest on a broad biologic basis. He has also shown that the phagocytes besides acting as digesting cells and as scavengers, are also the chief defenders of the vertebrate organism against invading bacteria. The diapedesis of the white corpuscles, their migration through the vessel wall into the cavities and tissues, is one of the principal means of defense possessed by an animal." In brief then, it is the general opinion that in the stage of suppuration the chief location of germs is intraleucocytary.

But what about leucocytic phagocytosis in purulent inflammations of the conjunctiva? What rôle does it play against bacterial invaders of this mucous membrane? If we refer to the fight that takes place between the tissues and the bacteria within the confines of the conjunctiva, then the leucocytes play no rôle whatever. In the first place the leucocytes seem to pour thru the conjunctival tissue, together with the serum, so rapidly that one would scarcely expect them to take an active part in the fight. As a matter of fact in all wet fixated sections of conjunctival tissue not a single leucocyte which showed phagocytosis has been observed. Even in the secretion, where the leucocytes begin to appear as the inflammatory symptoms get worse, no phagocytic action by them is observed in the early stage when epithelial cell phagocytosis has already begun. Only as the fight within the affected tissues becomes more intense, and more bacteria are thrown into the secretion, do the leucocytes begin to act. Even then epithelial cell phagocytosis in the conjunctiva is more active than is leucocytic phagocytosis in the secretion. Later on when the fight is being won inside the conjunctiva itself, and when epithelial cell phagocytosis is in consequence much reduced, leucocytic phagocytosis becomes more and more prominent. In any case it acts only against bacteria which are no longer parasites, i.e., against those which have been cast off and been washed into the secretion. But by this time the fight has been won and the bacteria have disappeared, or at least practically so from the conjunctival tissue. In conjunctival inflammations the function of leucocytes may therefore be likened to camp followers who clean up the field and bury the dead.

It is my conviction that they play no part in the actual fight against the parasitic invaders. As a matter of fact leucocytes are numerous only in gonorrheal ophthalmia, certainly not in pneumococcus or Koch-Weeks' conjunctivitis.

There have already been mentioned four causes of the halting of the bacteria in their penetration into the conjunctiva, and of their final disappearance from the tissue. As a fifth cause there should be mentioned a local acquired immunity, in areas where the ectotoxins have been severe and where their presence has resulted in an entirely new conjunctival structure.

I want to report that I have seen during the past few months, six cases of purulent conjunctivitis in the newborn caused by the pneumococcus. Lindner[2] once made a published statement that in his opinion there are only two causes of ophthalmia neonatorum, viz; gonococcus and inclusion blenorrhea. He now admits that he was wrong.

No attempt was made to determine the type of pneumococcus, that was found either in the newborn or in the adult cases. It was not possible on account of the lack of facilities in the laboratory in Vienna to do this; nor was it possible for the same reason, to establish with all the biologic proofs the absolute identity of this microorganism. I am quite aware of the difficulty in differentiating the pneumococcus from the streptococcus, and that the differential test is the solubility of pneumococci in bile while streptococci are not soluble. But the growth of pneumococci in culture media is quite different from that found taking place in parasitic fashion on the surface of the mucous membranes of the eye, where the germs are not seen in chains, long or short, but always in pairs as seen in Fig. 6.

Reference has been made to the fact that three of the parasitic microorganisms have been observed growing in great abundance on the surface of the corneal epithelium, generally without producing any clinical symptoms whatever. It is not possible to state definitely how dense the gonococci grow on the cornea, but in the two cases whose cornea I examined the relative number of germs on the individual cells was approximately one half of that found growing at the same time on the bulbar conjunctiva. In cases of conjunctivitis due to pneumococci or Koch-Weeks' bacilli, the growth on the cornea is far greater than the growth that takes place on the bulbar conjunctiva. In fact, in one pneumococcus case, where scrapings were made from the central region of the cornea, the germs not only were growing packed closely together, but appeared to be more than one layer deep (Fig. 7). I do not believe a growth so dense occurs anywhere else on the surface of the mucous membrane of the eye. It is probably due to the fact that the surface cells of the cornea are flatter and less viable than those of the conjunctiva and on that account do not possess the same power to combat the germs. The same cause probably accounts for the relatively denser growth on the bulbar conjunctiva as compared to that on the palpebral part.

The remarkable thing about the cornea is that it can be covered with the same kind of bacteria which are so toxic for the conjunctiva, without producing any clinical symptoms whatever. The cornea apparently acts in quite a different way towards the epithelial cell parasites than does the conjunctiva. Lindner[11] believes that it is because the cornea is without blood vessels, that toxins diffuse into the cornea but are not able to give rise to local changes, such as sudden and active proliferation of the deeper epithelial cells, because the exudation of serum from blood vessels into the corneal substance is wanting. And furthermore that the cornea being less viable, reacts to all external injuries and stimuli in a much slighter degree than does the epithelium of the conjunctiva. But the corneal cells being less viable than the conjunctival cells because they are flatter and more dried out, are also less nutrient for the same reasons. Then there soon comes a time when the turf of germs suddenly disappears for no other reason than a lack of nutrition. The epithelium of the cornea apparently acts merely as a

mechanical protection against excitors of inflammation.

From the behavior of the corneal epithelium toward parasitic bacteria, one is justified in concluding that when an ulcer of the cornea follows in the course of an inflammation of the conjunctiva due to one of these excitors, it is brought about purely thru an injury to the corneal epithelium, whereby the closed cover is broken. One should possibly except the virulent infections of the gonococcus, whose toxins may finally dissolve the corneal cement substance, and ulcus serpens in old people whose corneal cells are less resistant than those in younger persons. But for whatever cause, once the surface of cornified epithelium is opened the bacteria grow in and, proliferating rapidly on their new hosts, produce toxins which loosen the intercellular and interlamellar cement substance of deeper layers. Unlike the conjunctival cells the deeper cells of the cornea respond tardily and feebly to the stimulus of the toxins. They are unable to begin a rapid proliferation because of the very meager nutrition. In consequence the exfoliation of epithelial cells and layers of cells is more rapid than the process of cell regeneration, and soon Bowman's membrane is laid bare. The toxins of such bacteria as the gonococcus and the pneumococcus apparently have a severe destructive effect upon the mesodermal tissue of the cornea, if one judges from the results that follow the laying bare of the substantia propria. One is surprised at the small amount of bacteria found in the floors of such ulcers, and can only conclude that the lack of blood vessels with their outpouring of serum is the cause of the slight resisting power of this tissue to the toxins of the comparatively small number of germs that are present.

I have never seen phagocytosis of bacteria by corneal epithelium. Its protoplasm is undoubtedly too hard and lifeless to permit such a process.

From the foregoing data and discussion the conclusion may be drawn, that the bacterial parasites of the epithelial cells of the conjunctiva and cornea are the gonococcus, which exercises a severe pathogenic rôle, the pneumococcus, Koch-Weeks' bacillus, and diphtheria bacillus, which have a more moderate pathogenic rôle, and the influenza bacillus which has only a slight pathogenic rôle. Extensive and independent investigations made by both Lindner and myself have failed to reveal any more than these five bacteria which are parasites of living epithelial cells of the conjunctiva and cornea.

B. Epithelial Cell Inclusions.

A. Trachoma and Inclusion Blennorrhea.

It is not possible, within the scope of this paper, to discuss the bacteriologic aspects of the trachoma problem in any adequate or satisfactory manner. I shall have to be content with the making of relatively brief deductions and conclusions from the work that was done by a few men prior to the war and from my own recent investigations.

An enormous literature on the subject of epithelial cell inclusions of trachoma and of some other diseases has appeared. Halberstaeter and Prowazek[12] first published their observations in 1907. Unfortunately the war put a stop to all important investigations of the trachoma problem. In fact no important advances in our knowledge or understanding of the trachoma inclusions have been made since 1913. Perhaps one might justly say that the subject has been somewhat more confused since then by the numerous attempts to introduce many other diseases of unknown etiology into the group that are characterized by epithelial cell inclusions. In my estimation, Lindner has gone into the subject of trachoma and inclusion blennorrhea more deeply and more scientifically than any other investigator, and that is one reason why I recently spent several months in Vienna.

It was Lindner[13] who first proved the existence of free initial bodies in trachoma specimens and who showed photographs of them in various stages of development or division. It was he[14] who demonstrated the significance of inclusion blennorrhea in the newborn. It was Lindner[15] who developed new fixing and staining methods whereby he was able to demonstrate the relationship that exists between

the inclusion bodies and the epithelial cell; which had not even been suspected before, and which even today is not generally known.

In an article published only a few months ago, Simon[16] sums up the situation regarding our knowledge of trachoma in these words: "A great deal of work is evidently yet to be done before this problem is solved and it is rather surprising that during the past ten years so few investigations in this direction have been undertaken. If the enormous importance of trachoma, as a public health problem and as a source of human misery in so many parts of the world, be borne in mind this should constitute a sufficient impetus for prompt and active investigation, aside from its interesting scientific aspects." I believe I can fully appreciate Simon's point of view, for having lived for most of the time since 1910 in a country where at least 100 millions of the population have the disease, and where as an economic problem it appears to be getting worse, and where it constitutes in the opinion of many the chief single obstacle to China's advance in prosperity and industrial development, the subject of trachoma has become to me almost a "mania", using the term expressed by some of my friends. But I make no apology for introducing the subject into this paper, for I am convinced it belongs here and hope to be able to justify myself in your eyes for doing so.

In acute cases of trachoma and inclusion blennorrhea free initial bodies may be found in specimens obtained from practically any area of the bulbar or palpebral conjunctiva. But I have been unable to establish any evidence that the initial bodies grow as parasites on the surface of the living epithelial cells of the conjunctiva and cornea, in the manner that the parasitic bacteria do. At least topographic examination of the surface, with interpretation of the findings as applied in the case of the parasitic bacteria, produce negative results. But the findings of epithelial cell parasites in scrapings made in the usual way from conjunctivas affected by trachoma or inclusion blennorrhea are far from negative. One finds that the difference between bacteria and inclusion bodies as parasites is merely one of location, in their association with the epithelial cells. In brief the parasitic bacteria proliferate on the surface of the cell; initial bodies proliferate within the cell.

But, someone says, you are taking too much for granted in accepting the constituent granules of these cell inclusions as animate bodies. It is not my intention to dispose of the question of the biologic character of the inclusion bodies, either by avoiding it or sweeping roughshod over it. Those who consider the inclusions as products of cellular reaction, particularly of the nucleus or the nucleolus, have probably never seen specimens stained by Lindner's contrast method. With Giemsa's standard stain the nuclei of epithelial cells, leucocytes and lymphocytes, all bacteria, and the initial bodies of trachoma and inclusion blenorrhea stain a dark blue. This stain is differential only for the granules of mast cells which stain red. That is, one is in no position to assert from the color alone that the inclusion granules have not originated from either the nucleus or the nucleolus. With the contrast stain the differentiation in the basic reactions is much higher up in the scale. The nuclei of epithelial cells, leucocytes and lymphocytes are not stained blue at all, nor does their protoplasm stain. On the other hand all bacteria and the initial bodies, still keep the same deep blue color that they have in Giemsa specimens. If initial bodies are the products of cellular degeneration and more specifically of nuclear degeneration, they certainly would not stain blue, but rather red, if they take any color at all. But as a matter of fact cellular degenerations, either of protoplasm or of the nucleus, with the contrast stain are inclined to take on a red color. If so why should not initial bodies react in the same way to the stain, if they are nothing more than cellular reaction products? Furthermore, if there exist such reaction products of epithelial cells as these, why should we not get them in epithelial cells in cases of conjunctivitis caused by any or all of the para-

sitic bacteria? But we never do get such a picture. However, cellular reaction products are found in some epithelial cell specimens from every one of the purulent inflammations of the conjunctiva, including acute trachoma and inclusion blennorrhea; but they are not stained blue by the contrast method and one would never mistake them for real inclusions. The conclusion must therefore be drawn, that bacteria and initial bodies are closely allied and have a biologic similarity.

Those who question the animate character of initial bodies in the inclusions have evidently disregarded the existence of free initial bodies, which morphologically are identical with the blue bodies within the epithelial cells. The developmental stages of the bodies are seen taking place within the cell and outside the cell; but for obvious reasons such stages are better visible outside of the cell. There is one difference: the free initial body fades, even in Giemsa specimens, far more quickly than do the initial bodies within the cells. Then again if the inclusion bodies are not animate how can one explain the fact that Noguchi and Cohen[17] were able to culture them and reproduce all the various stages of development and division that one sees in specimens taken directly from the conjunctiva. That these investigators were unable to reproduce the disease in monkeys, by inoculating their conjunctivas with material from the cultures, is quite another story.

But the most striking evidence we have that initial bodies are animate, and are not merely reaction products of the cellular substance, is obtained by the examination of scrapings and sections of conjunctival tissue prepared by wet fixation. The picture is so different from that seen in dry fixated specimens that one is quite astonished, and any doubts that he may previously have had regarding the parasitic character of the initial bodies are now dispelled. Whereas in dried specimens the blue bodies are almost always massed together with scarcely any visible space between them, in wet fixated specimens the cells maintain their original shape and retain their fluid constituents and the blue initial bodies are not matted or crowded together but stand out quite separate and discrete from one another. Furthermore, they are found to be located inside a space which apparently contains a fairly clear fluid. The initial bodies are practically all seen to be arranged around on the periphery of this space, sticking to the cellular cytoplasm, apparently with no other object than that of feeding upon it. Cells with inclusion spaces of all sizes are seen, i. e., some cells with small spaces and a few initial bodies located on the periphery of the spaces, and others with large spaces and many blue bodies. If one examines his wet fixated specimens carefully he will observe, especially in advanced cases of inclusion blennorrhea, that the size of the inclusions most always has to do with the thickness not the lateral extent of the cell, and with the amount of the cytoplasm. In other words, the proliferation of initial bodies within the cell is directly in proportion to the amount of the cytoplasm. If one can be convinced of the parasitic nature of certain bacteria, by seeing them massed turf like over the surface of epithelial cells, as is illustrated in Plate XXIV, he should be just as easily convinced of the parasitic nature of the initial bodies of trachoma and inclusion blennorrhea by seeing them massed over the periphery of the inclusion space, sticking to the protoplasmic wall as seen in Fig. 15.

But the inclusion bodies found in trachoma and inclusion blennorrhea are not always blue. Many times we see tiny red bodies in the same space together with the large blue bodies, sometimes we see only red bodies. I have purposely refrained from referring to the red points or elementary bodies up to this point, because I desired first to establish a biologic analogy between the blue stained bacteria and the socalled initial bodies as seen both in Giemsa and contrast specimens. What is the significance of the elementary bodies? Prowazek[18] gave the name of chlamydozoa or mantle bodies to trachoma inclusion bodies. But at that time he thought that the red elementary bodies were the active virus which, after invading an epithe-

lial cell generates the deposition of a reaction product around the individual granules, thereafter staining blue with Giemsa. But Prowazek suggested this name and indicated what he believed to be the character of the elementary bodies, before Lindner[13] had discovered the existence of free initial bodies. Unfortunately Prowazek did not live to complete his studies. In the light of our present knowledge gained chiefly by the use of wet fixation of scrapings and sections, it now seems quite certain that Prowazek's conception of the elementary and the initial bodies was wrong and that the name of mantle bodies is a misnomer. This is the firm conviction of both Lindner and myself, and we believe that when wet fixation of specimens is employed our point of view will be accepted.

I have described in considerable detail the transition stages that take place between an initial body and an elementary body. My interpretation of these transition stages is briefly this: The initial body is chronologically always the first to appear in the cytoplasm of the cell. It grows and divides, going thru a regular cycle, its method of proliferation. The proliferation of initial bodies continues within the cell until all the cytoplasm is consumed. Numbers of the initial bodies then escape thru the thin protoplasmic wall and other cells, as yet unaffected, take them in. It is also quite probable that there comes a time in the case of some cells, when the cell membrane gives way and permits the initial bodies to escape. But in many other cells the initial bodies appear to be unable to escape from their host and therefore die. As the blue stained initial bodies die they gradually fade and then thru the faded substance of the microorganism there appears faintly visible a red point in the center. Finally the substance around the red center disappears entirely. Sometimes the dying process does not take place simultaneously on the part of all the initial bodies; and then one may see in cells examined in this stage that some bodies are blue, some fading with red points in their center and some which are now the red bodies without any evidence of a coat around them. Of course in time all the initial bodies that do not escape die and then we see inclusions containing nothing but numerous fine red elementary bodies. They are stained red both in Giemsa and Lindner's contrast stain. The initial bodies must therefore be the active virus and the elementary bodies the degenerated forms. This certainly is a far simpler conception than Prowazek's and has a large amount of evidence in favor of it.

But translated in the terms of the final reactive process of the epithelial cells of the conjunctiva against the germ parasites, there is another conception of the inclusions of trachoma and inclusion blennorrhea which should now be suggested. I refer to epithelial cell phagocytosis of known parasitic bacteria such as the gonococcus, the pneumococcus and the Koch-Weeks' bacillus. With phagocytosis by the epithelium of the conjunctiva as a regular process, established as an actual fact, is it not easier to comprehend the process which in a regular way takes place in trachoma and inclusion blennorrhea? We have been accustomed to think of the inclusions within epithelial cells of the conjunctiva, of the parasitic bodies characteristic of these diseases, as an unusual and isolated phenomenon. But the inclusion of parasitic microorganisms within epithelial cells is a process not characteristic for the initial and elementary bodies alone. We now know it is equally characteristic for microorganisms which have an accepted bacteriologic status. Therefore why not call the process one of epithelial cell phagocytosis in both, and get away from the term inclusion? In brief, does not this knowledge of the process of epithelial cell phagocytosis of bacteria make it clear that what happens in trachoma and inclusion blennorrhea is the same thing? But there is a difference between the bacteria referred to and the inclusion bodies in their reaction to ingestion. Bacteria are parasites of the cellular surface cement substance, but upon being phagocytated are killed by the cells and become digested. Initial bodies are also ingested by the same type of cells, but instead of being killed they

immediately begin to multiply within their host, and continue to multiply until the cytoplasm is consumed. But this difference is not so strange as one might think, for this intracellular multiplication on the part of the initial bodies is not an isolated phenomenon. Ten Broeck[19] has given us an analogy in the case of the bacillus muriseptic us. Following injection of these bacilli into mice he found the germs were taken up by the endothelial cells lining the veins and capillaries. But he observed that the phagocytated bacilli multiplied within the endothelial cells and killed them, indicating that in the cells the bacilli find a favorable medium for their growth. And then he adds that "while phagocytosis may in general be an immune reaction, in this case it appears to favor the parasite rather than the host." So inclusion bodies may not be so much different from bacteria after all. In this connection I want to state that leucocytic phagocytosis of inclusion bodies also takes place in acute cases, but only in a very moderate degree. There is no evidence that the bodies multiply within the leucocyte.

From the experimental work on pavian monkeys done by Botteri[4] and Lindner[20] the biologic similarity of trachoma and inclusion blennorrhea has been established. They were found to be identical in the following ways: period of incubation (5 to 10 days), secretion containing the virus rendered inocuous by drying in the same length of time, reciprocal immunity, length of time that the free initial bodies and inclusions may be found, filterable character of each virus, analogous histologic changes in the conjunctiva, reinfection possible in both diseases but with the length of the interval depending upon the severity of the first infection.

Lindner[14] found that a pregnant mother, whose vaginal discharge contained gonococci and in whose vaginal scrapings epithelial cell inclusions were also found, would not transmit the gonococal infection to her child if the Crede method of prevention was used; but that the child would always develop an inclusion blennorrhea in spite of the silver nitrat instillation. This should answer Williams[22] and all others who have tried to prove that inclusion bodies are merely intracellular nests of growing bacilli in their transitional forms, especially the hemoglobinophilic bacilli and the gonococci.

From my own experience and observations and from a study of the subject from every conceivable angle, I have practically come to the conclusion that trachoma and inclusion blennorrhea are biologically identical, but that clinically they are somewhat different. In fact I believe that there are two types of trachoma; ocular trachoma or the chronic insidious type, and genital trachoma or the acute type. Also that inclusion blennorrhea of the newborn and acute trachoma in adults are both genital trachoma in matter of origin.

B. Inclusions of Vernal Catarrh.

Botteri[4] was the first to discover and report inclusions in epithelial cells from the conjunctiva in cases of vernal catarrh. Lindner has also found them. I have found them in one case. Morphologically the inclusion bodies are identical with the inclusions of trachoma and inclusion blennorrhea, but the inclusion is always very small. The initial bodies apparently do not proliferate as abundantly or as rapidly as they do in the other two diseases. Elementary bodies are also found according to Botteri. This completes the list of inclusions of the human conjunctiva.

There is another disease in which epithelial cell inclusions have been found in specimens from the conjunctiva and that is hog cholera. Uhlenhut[21] was the first to demonstrate the inclusions in this disease. The constituent blue granules are somewhat larger than in the other inclusion diseases, otherwise it is morphologically identical with the other three. The interesting thing about the conjunctival cell inclusions in hog cholera is that all the indications point to its being an endogenous infection in that area, that is a blood borne infection. The disease cannot be transmitted to the conjunctiva of man.

I have examined under the microscope several of the other types of so-called epithelial cell inclusions such as

molluscum contagiosum, epithelioma contagiosum of pigeons, vaccinia, paravaccinia, variola and herpes, but they are all so vastly different from those of trachoma, inclusion blennorrhea, vernal catarrh and hog cholera that I am unable to think of them as being anything else than cellular reaction products, which the inclusions of the other form are not in my opinion.

II THE SAPROPHYTIC BACTERIA OF THE CONJUNCTIVA.

Thus far in the discussion, the microorganisms that have been shown to be excitors of purulent inflammation of the conjunctiva are five parasitic bacteria and the socalled inclusions. This group is so small that one wonders whether there are not saprophytes which exercise a pathogenic rôle upon the conjunctiva.

According to my investigations the diplobacillus of Morax-Axenfeld, the xerosis bacillus and the staphylococcus are found very frequently free in the conjunctival secretion, or growing upon dead epithelial cells or shreds of mucus and other debris that may be found lying on the lid margins, or on the surface of the conjunctiva either of the bulbus or of the palpebra, or in the secretion itself. In no instance have I found any one of these bacteria growing upon the living epithelial cells of the conjunctiva.

If we interpret the clinical picture associated with the presence of these germs, then there is no other conclusion than that the staphylococcus and xerosis bacillus are common saprophytes of the conjunctiva, whose toxins exert a nonpathogenic rôle, and that the diplobacillus only occasionally exercises a pathogenic rôle. The latter occurs when the diplobacilli are found growing in great numbers on the skin surface and lid margins at the canthi. Thru their toxins they produce an irritation of the conjunctiva which is known as angular conjunctivitis. Sometimes the diffusion of toxins from the diplobacilli into the conjunctival tissue is so great, or effective, as to produce a purulent inflammation, but this happens only in rare cases. The pneumococcus has been included among the parasitic bacteria of the conjunctiva. As a matter of fact it is found more often as a saprophyte, i.e., growing only on dead cells or debris, in the same manner as do the staphylococcus and xerosis bacillus. For some unknown reason this germ may suddenly begin to grow upon living epithelial cells of the conjunctiva. It then becomes pathogenic and excites a purulent inflammation. Pillat[7] found this germ growing as a saprophyte on dead cells and debris in the region of the bulbar conjunctiva, in 40 per cent of a group of individuals who had no conjunctival inflammation at all. According to Lindner[11] the presence of this germ on the bulbar conjunctiva as a saprophyte possibly explains the cause of many postoperative infections of the eye. That is the pneumococcus may be carried from the conjunctiva directly into the eye by the instruments and finding there a favorable medium for growth produce a violent reaction. This explanation is a reasonable one because panophthalmitis is rarely caused by any other microorganism than the pneumococcus. Streptococcic infections of the intraocular structures are metastatic in origin.

Leucocytic phagocytosis of saprophytic bacteria occurs only following acute inflammation of the conjunctiva, after the primarily invading parasites have disappeared and when the saprophytes, taking advantage of the debris in the conjunctival sac, grow in the presence of pus cells. But saprophytes are never found phagocytated by the epithelial cells of the conjunctiva.

It may be that there are other parasitic microorganisms of the mucous membrane of the eye than the five bacteria and the three epithelial cell inclusion bodies that I have mentioned. In any case it seems to me that before others are included in the list it should be proved that they grow and proliferate either on the surface or in the protoplasm of the epithelial cells. And if they do proliferate in this way, then they produce ectotoxins which have a pathologic effect upon the cells in that area, as evidenced by definite clinical signs.

It may be too that there are other saprophytes besides the Morax-Axenfeld bacillus, which produce toxins

effective enough to cause an irritation or inflammation of the conjunctiva. At any rate I believe the principle has been established that the presence of bacteria, whether few or many, in the conjunctival secretion, and the results of cultures made from smears from the secretion do not in themselves prove the etiology of an existing inflammation.

In conclusion, perhaps it is not too much to add that the study of the bacteriology of the eye is not a closed book, as has been thought by many of us for a number of years. It is possible that an enlarged conception of the relation between parasitic microorganisms and the epithelial cells of the mucous membrane of the eye, and a new conception of the function of the epithelial cell in inflammations of this structure may help us to understand more clearly the pathologic processes and the tissue reaction that take place. Finally we may have a better basis for determining the character of the infections of all the other mucous membranes of the body.

SUMMARY.

1. The microorganisms associated with the mucous membrane of the human eye are classified into the parasites and the saprophytes. All the parasites exercise a pathogenic rôle.

I. The parasitic microorganisms
   A. Bacteria
      1. Gonococcus
      2. Pneumococcus
      3. Koch-Weeks' bacillus
      4. Diphtheria bacillus
      5. Influenza bacillus
   B. Epithelial cell inclusions
      1. Trachoma
      2. Inclusion blennorrhea
      3. Vernal catarrh

II. The saprophytic microorganisms
   A. The one having a pathogenic rôle
      1. Diplobacillus of Morax-Axenfeld
   B. Those having a nonpathogenic rôle
      1. Staphylococcus
      2. Xerosis bacillus
      3. Pneumococcus (sometimes becomes a parasite and then plays a pathogenic rôle.

2. There may be other microorganisms than those named above which are pathogenic for the conjunctiva or for the cornea or for both, but to be classified as parasites it must first be proven that they grow on living epithelial cells; if they are saprophytes it must be shown that they produce toxins effective enough to cause inflammation.

3. The principle has been established that the presence of bacteria in smears from the conjunctival secretion and the results of cultures made from such smears do not in themselves prove the etiology of an inflammation of the conjunctiva or cornea.

4. The parasitic bacteria grow in dense turf like formation on the surface of the conjunctiva and cornea in the early stages of a conjunctivitis.

5. The ectotoxins of the parasitic bacteria diffuse into the tissue beneath them and produce a dissolution of the intercellular and interlamellar cement substance of the layers of epithelial cells of the conjunctiva, and thereby permit the bacteria to grow in. In no instance do they penetrate as deeply as the subepithelial tissue.

6. The superficial layer of cornified corneal cells, except in rare instances, successfully resists the bacterial ectotoxins. Therefore the bacteria which grow as parasites on the cornea produce no visible clinical signs of their presence whatever, but suddenly die and disappear when all the available nutrition is consumed.

7. The halting of the parasitic bacteria in their penetration into the conjunctival tissue and the termination of the infection are due to the following factors:

   a. The early casting off of the superficial layer with its dense turf of bacteria.
   b. The outpouring of exudates thru the breaks in the epithelial cover against whose current the bacteria must grow.
   c. An extensive and increasing proliferation of the deeper epithelial cells, which results in a continuous exfoliation of cells as layer by layer the deeper cells become superficial.

d. Phagocytosis of the invading bacteria by the epithelial cells of the deeper layers.

e. A local acquired immunity in areas where the ectotoxins of the parasitic bacteria have stimulated the generation of an entirely new conjunctival structure.

8. Epithelial cell phagocytosis and digestion of parasitic bacteria occur regularly, as the last offensive process in the line of defense in the fight of the epithelial cells against the excitors of purulent inflammation of the conjunctiva.

9. Leucocytic phagocytosis seems to play no part in the fight that takes place within the tissues, between the epithelial cells and the invading bacteria. The leucocytes are effective as phagocytes only against bacteria which have been loosened from their hosts and then thrown into the secretion.

10. To Metschnikoff's classification of phagocytes, which he limited to a highly differentiated group of cells of mesodermal origin, must now be added cells of ectodermal origin, viz: the epithelial cells of the conjunctiva which is one of the mucous membranes of the body.

11. The rôle of the epithelial cells of the conjunctiva, as revealed in their fight against parasitic bacteria, is indicative of what very probably takes place to some degree at least in all the other mucous membranes of the body.

12. In the light of our new knowledge and the proof of epithelial cell phagocytosis of parasitic bacteria, our conception of the epithelial cell inclusion bodies in such diseases as trachoma is greatly simplified, i.e., the ingestion of microorganisms is not unique for the latter alone.

13. The parasitic bacteria of the conjunctiva are parasites of the surface substance of the epithelial cells and when the bacteria become ingested, they die and become digested as do bacteria which are phagocytated by leucocytes.

14. The inclusion bodies are parasites of the cytoplasm of the living epithelial cells which ingest them and are not killed by the cells, but proliferate within the cells on the surface of the inclusion space until they consume all the cytoplasm.

15. Intracellular proliferation of microorganisms is not a process or a phenomenon unique for inclusion bodies alone; it also occurs in the realm of known bacteria, e. g., the bacillus murisepticus is phagocytated by the endothelial cells (mesodermal phagocytes) of blood vessels in mice, and proliferates within the substance of these cells.

16. The initial bodies of trachoma, etc., which are stained blue by Giemsa or Lindner's contrast method are without doubt chronologically the first to appear, and for this and other reasons should be considered as the active virus of these diseases. Whether the initial bodies are bacteria or protozoa is a problem which must be settled by bacteriologists.

17. The red stained elementary bodies, in my opinion, are degenerated initial bodies; and should therefore not be classified as chlamydozoa or mantle bodies.

18. The inclusion bodies of trachoma and inclusion blennorrhea have been shown by Botteri and by Lindner to be biologically identical.

19. It is my opinion that there are two types of trachoma:

a. Ocular or insidiously beginning chronic trachoma.

b. Genital trachoma, which in the matter of origin includes inclusion blennorrhea of the newborn and acute trachoma of adults.

20. The use of wet fixation of scrapings and of tissue sections is quite necessary if one is to get an adequate picture of the relationship of the initial bodies and the elementary bodies to each other and to the epithelial cells within which they are found.

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THE RECOGNITION OF EPITHELIAL PARASITES.

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Application of the observations of Lindner and Howard to the diagnosis of conjunctivitis gives more trustworthy evidence than the older method of making smears from conjunctival secretion. The simple modifications of technic necessary are here described.

The mechanism of conjunctival inflammation was exceedingly vague, until Lindner advanced the theory that the pathogenic bacteria which affect the mucous membrane of the eye are epithelial parasites. His discovery has revolutionized our conception of the modus operandi of conjunctival infections. It is unfortunate that the importance of the original paper was not fully appreciated.

That bacteria are frequently present in the epithelial cells of the conjunctiva has been known for some time. S. Hanford McKee called our attention to this fact in 1912. However, he did not emphasize the importance of the relation of the bacteria to the epithelial cells, nor did he advance the theory that they were epithelial parasites.

We are fortunate in having so able an investigator as Dr. Harvey Howard review Lindner's work; and give us a detailed account in this JOURNAL of the results of his investigation of the subject. His paper is worthy of careful study by every ophthalmologist, because certain phases of it are of the greatest importance in every day practice.

The old method of making smears from the conjunctival secretion is unsatisfactory for several reasons: (1) The most important being that the bacteria are found primarily in the epithelium and not in the secretion. (2) The organism confined to the epithelial cells in the earlier stages, and secretion is frequently not present until the disease is well established. (3) In many instances the bacteria are so

scattered by exudate that they are difficult to find in the secretion, when they may be present in large numbers on, or in the epithelial cells. (4) A secondary growth of bacteria may be present in the secretion and be misleading.

By Lindner's method of making epithelial smears we are frequently able to determine the nature of the causative organism, several days before secretion appears. This is obviously of great practical importance; especially in gonorrheal ophthalmia, where an early diagnosis may save vision, by enabling one to institute specific therapy before the inflammation is advanced.

The morphology of the microorganisms that cause conjunctivitis is so characteristic, that after a little practice with the microscope one will find it easy to recognize the organisms of the various forms of conjunctivitis. Epithelial smears are not difficult to make and any ophthalmologist can take them in his office without difficulty. The instruments necessary are a platinum spatula, with a moderately sharp edge to scrape off the epithelial cells. (The platinum loop used by bacteriologists is not satisfactory for this purpose because it slides over the surface of the conjunctiva and does not remove the deeper layers of epithelium.) A spatula can easily be made by pounding the end of a firm piece of platinum wire until it is flattened, the wire inserted into a handle, Fig. 1. A Bunsen burned, or spirit lamp is used for sterilizing the spatula. Thoroly cleansed, square No. 1, 22 mm. cover glasses and glass slides; staining dishes with concave bottoms or deep watch crystals are needed. Also absolute alcohol, Loeffler's methylene blue, Giemsa stain, saturated alcoholic methylene blue, 1 per cent solution of acetic acid, distilled water, filter paper and cedar oil must be at hand. The solutions can be purchased at any biochemical supply house.

Fig. 1.—Platinum spatula for scraping conjunction, to secure epithelial cells for examination.

The conjunctiva should be anesthetized by instilling, first a 5%, and a few minutes later a 10%, solution of cocain. The platinum spatula is sterilized by passing it thru the flame, and when it has cooled, the upper lid is everted and the debris removed from the surface of the conjunctiva with a clean piece of cotton. The surface of the conjunctiva is then scraped with the edge of the spatula, exerting enough pressure to remove the epithelium, but not enough to cause bleeding. The material on the spatula is then smeared on the surface of the cover glass, as thin as possible. Smears should be taken in the same manner from the upper and lower bulbar, and lower palpebral conjunctiva, as described by Lindner and Howard. If localized areas of inflammation are seen, the smears should be taken from them.

For clinical purposes, staining with Loeffler's methylene blue is sufficient for the study of bacteria. This can be done very quickly. After placing the smears on the glass they are dried in air and fixed by covering the surface of the cover glass with absolute alcohol. After the alcohol has evaporated, the smear is covered with Loeffler's methylene blue solution for two or three seconds, and quickly washed off with distilled water. If the staining is done quickly, the bacteria and nuclei of the epithelial cells stain deep blue, and the protoplasm a delicate light blue. The cover glass is then mounted on the slide, film side down, in cedar oil. Cedar oil that is used with the oil immersion lens is employed for this purpose. The smears are then ready for microscopic examination.

For the study of initial bodies and the epithelial inclusions of trachoma, the Giemsa solution, or Lindner's contrast stain, must be used. These solutions stain bacteria exceedingly well and if one is not in a hurry to make a diagnosis, they are superior

to Loeffler's methylene blue method. The methods are fully described in Howard's article. To remove the metallic scum that forms on the stain, the edge of a piece of filter paper should be drawn over the surface of the stain, until the surface is clear. If this precaution is not taken, the metallic substance will adhere to the cover glass, and be seen as granular debris when examined with the microscope.

Preparations by the wet fixation method are interesting, because they show the exact relation of the bacteria to the cells. This method will appeal to the scientific investigator; but for the purpose of making a clinical diagnosis it will rarely be used. The same is true of preparing sections.

A FURTHER CASE OF AGRICULTURAL CONJUNCTIVITIS.

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OMAHA, NEBR.

This case is reported from the Department of Ophthalmology, University of Nebraska Medical College.

On account of the bacteriologic findings and the fact that no other cases have been reported from our section of the country since our first report, the following later case illustrating the condition which we have called agricultural conjunctivitis is reported. Six cases of this condition were reported in the American Journal of Ophthalmology in 1922 and a further case in the same journal, September, 1923.

Fig. 1.—Large bacillus found in case of agricultural conjunctivitis. Gram positive, and grown in anaerobic cultures.

Dr. H. A. Smith of Delta, Colorado, in a personal communication reports that he has seen three cases which correspond to our first cases in all essentials. His last case, seen in 1917, was that of a farmer in which there was a history of possible contagion from a horse which had a discharge from the eyes and nose. The cornea was involved, the vision being 20/100. The family doctor of this patient apparently contracted the infection from him.

The report of our most recent case is as follows:

John B., a farmer thirty-one years of age, living at Wakefield, Nebraska, appeared April 10, 1924 on account of pain and inflammation in the right eye. The left eye was normal, vision in the right eye was 10/200 with very marked swelling of both lids. The lids, tho somewhat swollen, could be turned; and several ulcers covered with grayish exudate were seen along the upper border of the tarsus and in the upper fold. The corneal epithelium was absent over a circular area including the center of the cornea and the margin below it. One area of necrosis of the skin was present near the inner angle of the upper lid. The patient could not remain for treatment but was referred to his family doctor with instructions for frequent irrigations with a boracic collyrium and the use of a weak zinc collyrium twice a day.

He returned in a few days when the condition was considered worse, the swelling of the lids was more marked and there was now distinct swelling and tenderness of the preauricular glands. The small ulcers on the conjunctiva had fused to form a large area, covered with membrane, occupying most of the tarsus and upper fold. The erosion of the cornea was about the same as when first seen. The necrosis of the skin was healing. The patient was put in the hospital and given intensive treatment including frequent irrigations, milk injections,

and atropin. He improved considerably, the swelling of the lids decreased and the corneal erosion became smaller. The patient insisted on returning home before the erosion had disappeared.

Six weeks after he was first seen the patient returned with the swelling of the lids almost gone, but the cornea in much worse condition than at first. The central area now showed deep infiltration and there was deep pericorneal congestion. Vision was light perception. The patient again insisted on going home and has not been seen since. A report from Dr. Weyer, his family physician, states that when last seen vision was counting fingers at two feet. The patient had been under the care of another oculist.

Smears from the membrane at the time of the patient's first visit showed several fields with large numbers of very large bacilli. These resembled in the morphology the large bacillus described in our previous cases of "agricultural conjunctivitis," being 5 to 10 microns long and some considerably longer and thread like. Most of these bacilli, however, were gram negative, being probably somewhat degenerated forms. Anaerobic cultures from the membrane showed a very scanty growth of large gram positive bacilli resembling in morphology the organisms found in smears and also the organisms previously described in agricultural conjunctivitis. In some tubes this was in pure culture, in others staphylococcus also grew. Growth in these cultures was very slow, hardly perceptible on the surface of the media. Injections of the scanty material produced after ten to twelve days growth anaerobically, when injected subconjunctivally in guinea pigs had no apparent effect.

Smears and cultures from the area of skin necrosis showed staphylococcus only.

This case, while it later developed typical characteristics of "agricultural conjunctivitis;" membrane formation, superficial necrosis of the skin, swelling of the lids and adenitis, was seen at an earlier stage than any of our former cases. The small discrete ulcerations which were present when we first saw it could easily have been mistaken for the lesions of Parinaud's conjunctivitis, altho there were no hypertrophied papillae. The corneal involvement is interesting as showing the severity of the process, there probably being enough absorption of toxins from the infected conjunctiva to cause superficial necrosis of the cornea, which is followed by extensive vascularization. The bacteriologic findings, tho complicated as in the other cases, showed also the unusual large anaerobic bacillus which, from its presence in these cases and its absence from the normal conjunctiva, would seem to be very probably the etiologic agent, in spite of its failure to produce characteristic lesions in animals.

FREELY MOVABLE INSTRUMENT FOR OPHTHALMOSCOPY WITH YELLOW GREEN LIGHT.

JONAS S. FRIEDENWALD, M. D.

BALTIMORE, MD.

An arc lamp is so mounted on the brackets as to be freely movable in all directions. Attached to the front is the support for a flat faced bottle in which a solution of anilin green naphthol is used as the light filter. The light obtained is relatively monochromatic so that the effect of the chromatic error of the eye is removed and an ophthalmoscopic picture of great distinctness is obtained. From the Department of Pathology, Johns Hopkins University.

Practically all the instruments previously devised for red free ophthalmoscopy are cumbersome, stationary and expensive; with those arranged in connection with self luminous ophthalmoscopes the light is feeble, and its spectral distribution unsatisfactory. The instrument which we are about to describe is simple, freely movable, and relatively inexpensive in construction. A similar, though less freely movable instrument has recently been described by Richard Krämer[1]. Our instrument (Fig. 1) consists of a Leitz liliput arc lamp, mounted on a telephone extension bracket. The pin on which the lamp stands revolves freely in a cup placed at the end of the extension bracket. The mountings of the arc lamp, as obtained from the Leitz Company, are so arranged that the lamp can be tilted down but not up. These mountings have been slightly altered in the writer's instrument so as to allow also an upward tilting of the lamp if desired. The lamp, then, can be moved about on the extension bracket, revolved in a horizontal plane, and tilted up or down. Despite this manifold freedom of movement the instrument is quite firm and stable. The arc lamp, with its con-

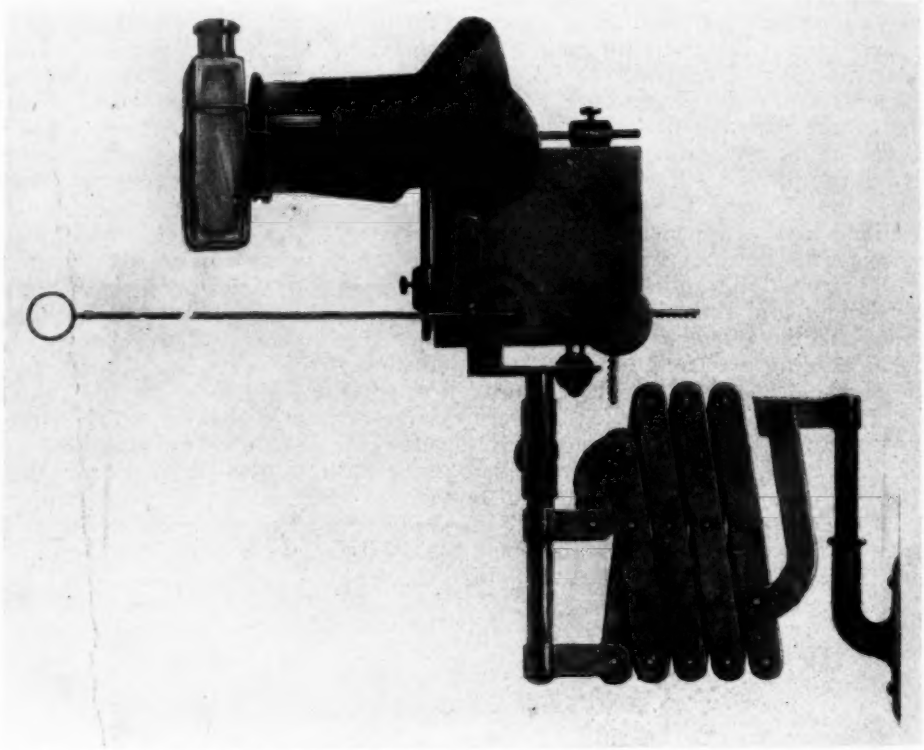

Fig. 1.—Bracket, arc lamp and filter attachment, to give yellow green light for ophthalmoscopy.

densing lens, as obtained from the manufacturer, has at its front end a cell into which a glass disc can be inserted. In front of this, in the writer's instrument, there has been added a metal basket to hold a flat faced bottle. By using glasses of various tints in combination with solutions of various sorts, almost any desired spectral distribution of emerging light can be obtained.

The choice of the light filter merits some discussion. It would appear that the full value of the control of the spectral range of the light used in ophthalmoscopy has not yet been realized, and that a careful consideration of the desiderata would lead to a much more satisfactory light than the usual bluish-green one encounters in most "red free" instruments. What is desired is twofold: (1) an increased definition in the image; and (2) an increased contrast in the ophthalmoscopic picture. The "red free" instrument as devised by Vogt was not

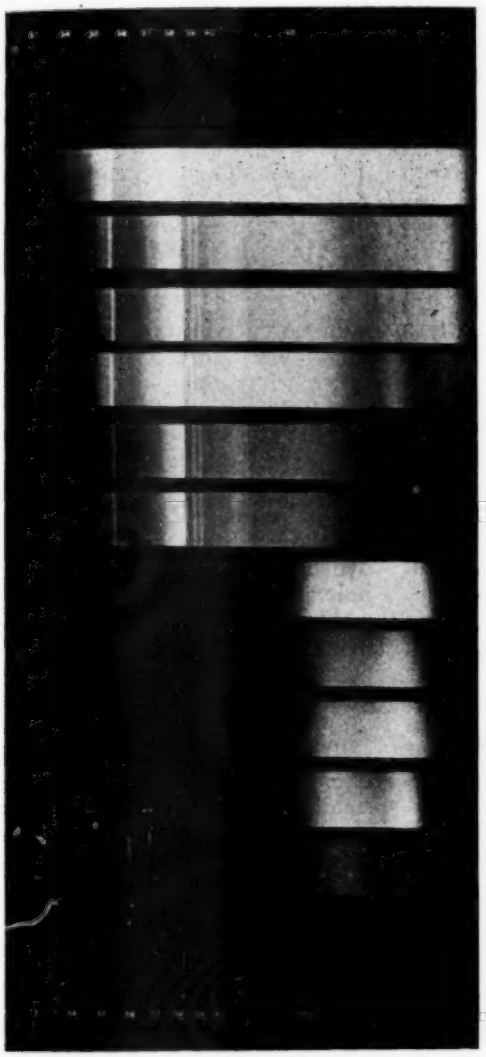

Fig. 2. Photographs of spectrum with and without filters.

planned to serve these purposes. It was devised to render visible the yellow pigmentation of the macula in vivo. Only as a corollary to this investigation was it discovered that the red free light rendered the ophthalmoscopic picture sharper and more contrastful.

There can be little doubt that the ill defined character of the ophthalmoscopic image as seen with white light is due in greatest measure to the chromatic aberration of the observed eye, and that the increased definition obtained with the "red free" instruments now in use is due to the more limited spectral range of the light employed. Reasoning in this way, one cannot escape the conclusion that the ideal light would be one of still more limited spectral range, in fact, a light which would be relatively monochromatic.

What light of limited spectral range will, then, give the greatest contrast in the ophthalmoscopic picture? Our choice will be based on a consideration of the elements of the fundus that we hope to see. The greatest usefulness of the "red free" light appears to be in the study of the retinal blood vessels. We desire, therefore, a light in which the blood will appear black or very dark, while the general background of the fundus appears as bright as possible. A study of the obsorption spectra of hemoglobin and oxyhemoglobin shows that both these substances transmit spectral red and to a lesser degree spectral green; both absorb very strongly spectral yellow (oxyhemoglobin has a narrow transmission band in the yellow which need not disturb us here) and the whole blue violet end of the spectrum. Assuming a limited spectral range in our light, the blood will appear black or very dark in either yellow or blue or violet light.

The retinal pigment epithelium is of a yellow brown color and, as can be seen from the studies of Koeppe[8], it reflects most strongly light from the yellow and green regions of the spectrum.

Our choice then is simple. For the maximum definition and the maximum contrast we need yellow light of limited spectral range. The requirements are, however, not as absolute as we have outlined them. The admission of yellow-green light in addition to the yellow does not visibly blur the image, nor does it detract appreciably from the blackness of the blood, while on the other hand the ophthalmoscopic picture is somewhat enhanced by this slight increase in the variety of color. A light filter which satisfies these various requirements was constructed with the kind aid of Dr. A. H. Pfund, Associate Professor of Physics at the Johns Hopkins University.

The filter used is a solution in glycerin of the dye aniline green naphthol B*. To this a blue glass may be added, if desired, decreasing the intensity of the light without appreciably altering its spectral constitution. In this light the fundus appears a bright yellow-green, venous blood is black, arterial blood not quite so dark. Connective tissue streaks, vessel walls, exudates and the like appear, after one has become slightly adapted to this light, almost white. The detail of fundal structure seen with the aid of this light considerably exceeds those pictured with other "red free" ophthalmoscopes.

Glycerin is used as the solvent for the dye because, having the same refractive index as glass, it avoids the necessity of making the inside surfaces of the bottle plane. If attention were not paid to this point, the light would be refracted at the uneven inside surfaces of the bottle and somewhat scattered.

The dye, naphthol green, is an extremely powerful one, and only a very small quantity of it is needed to make a satisfactory solution. In preparing the solution it is well to fill the flat faced bottle almost full with glycerin, make up a concentrated solution of the dye in a few cubic centimeters of glycerin and add this solution, drop by drop to the glycerin in the bottle, checking all the while by observing the appearance of a red object, say a two-cent postage stamp, when held in the beam of light which comes from the instrument. When the stamp appears black, the solution is sufficiently concentrated.

The rod which extends from the side of the lamp is copied after a device which the writer first saw in the clinic of Professor Zeeman in Amsterdam. The light of the arc lamp comes out in

*Eimer & Amend, New York, N. Y.

a very narrow cone, and some agility would be required of the ophthalmoscopist to keep the mirror of a reflecting ophthalmoscope within the confines of this beam of light while he moves about to examine various parts of the eye. By grasping the ring which is at the end of the rod, with a finger of the same hand with which he holds the reflecting ophthalmoscope, he can be assured that however actively he moves about, the beam of light will always follow.*

*The instrument can be obtained on order from Bowen & King, opticians, Baltimore, Maryland.

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SUTURING OF THE CONJUNCTIVA IN CATARACT OPERATIONS.

HARRY VANDERBILT WÜRDEMANN, M. D., F. A. C. S., Sc. D.

SEATTLE, WASHINGTON.

The history and advantages of sutures after cataract extraction are briefly referred to. The author's methods of suturing the conjunctiva after incision with a conjunctival flap are here described. Read before the Pacific Coast Oto-Ophthalmologic Society at the Portland meeting, July, 1924.

In no other important operation upon the body is a wound left to heal by itself without being sewed up, except in operations on the eye, as for iridectomy or cataract. It is true that in a well conducted operation immediate coaptation of the edges of the incision occurs, and healing commences within a few hours; hence suturing of the cornea or the conjunctiva is not practiced by all ophthalmic surgeons. Some, however, sew up the eye, and thereby feel that certain operative accidents, or secondary complications, are not so likely to happen. I have occasionally resorted to this procedure for thirty-four years, but only within the last three years have I made it a routine part of this operation.

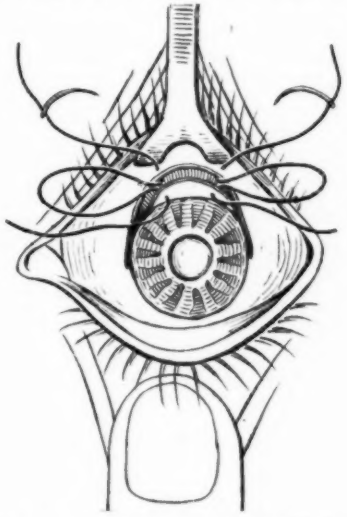

Fig. 1.—Corneoscleral incision for cataract extraction; sutures introduced in conjunctival flaps.

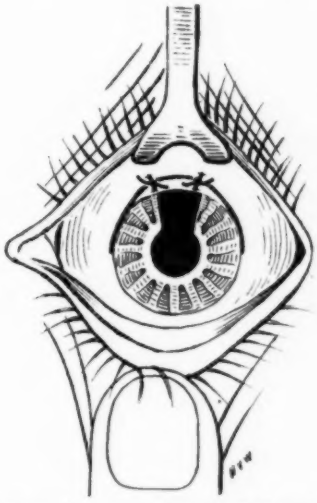

Fig. 2.—Operation completed, including iridectomy, and sutures tied, at end of operation.

Where a rather large loose conjunctival flap has been made, in a few cases the top has not been cut thru, leaving a conjunctival bridge, the lens has been extracted and the toilet

of the anterior chamber made quite as easily as if the section of the conjunctiva had been complete.

Williams, of Boston, in 1867 proposed the corneal suture, which was placed in the cornea and the sclera before the incision. This procedure was presented on account of certain advantages in prevention of iris prolapse. Without doubt, owing to the difficulty of placing the stitches, the liability of cutting the threads, its inconvenience and the necessity for its removal within a few days after operation, it is seldom used. Kalt brought it up again in 1890 and de Lapersonne later. Terrien now recommends it for all cases where the cataract is expected to be extracted without an iridectomy.

Fig. 3.—Square or reef.

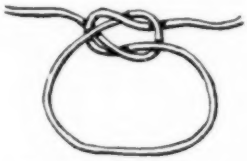

Fig. 4.—Granny knot.

In a recent paper read before the Section on Ophthalmology, American Medical Association by Harvey J. Howard of Peking, China, entitled "Conclusions Concerning a Scleroconjunctival Suture in Cataract Extraction," the following advantages of the scleroconjunctival suture are given:

1. In loss of vitreous it is of immediate help in quickly and quite securely closing the wound.
2. In impending loss of vitreous at any stage after the section has been made it is of equal value, and by control of the thread the wound can be kept open as widely or as little as one pleases, in order to complete the operation.
3. An ample opportunity is afforded to clear away all lenticular debris that is visible, which favors more rapid recovery and a better visual result.
4. There is immediate and secure coaptation of the wound as soon as the suture is tied.
5. There is quick reestablishment of the anterior chamber, reducing thereby the chances of secondary iris prolapse.
6. It will probably save the eye in cases in which the patients vomit or become violent following operation.
7. The healing of the wound is quicker and takes place with less scar tissue and less astigmatism.
8. The patients are permitted earlier and greater freedom of movement, which is of considerable importance in treating the aged.

The disadvantages of the suture are:

1. It requires the addition of about two minutes to the duration of the operation.
2. The flap does not heal so well or so smoothly as in uneventful nonsutured eyes.

It is quite unlikely that any safeguard will ever be found that will have no disadvantages. As for the scleroconjunctival suture, it is both my conviction and my experience that the weight of the argument is decidely on the side of the "advantages." It must not, however, be taken for granted that the use of the suture will compensate materially for lack of skill and experience, for the proper handling of the threads does require a certain amount of skill.

The question of the corneal suture is not under discussion in this paper, which is limited to suture of the conjunctiva, of which there are two methods, both adapted either to placing the suture before, or after the incision of the globe. The discussion is again restricted to suture of the wound after the incision of the globe. The suture may be placed either before, or after the iridectomy and extraction of the lens. Here again I restrict myself to speaking of the placing of the sutures after the incision, before the iridectomy and before the delivery of the lens.

METHOD No. 1, is generally used by the author as it is his habit to make a corneoscleral incision with a large conjunctival flap. Immediately after its completion, two stitches of No. 1, braided, black, iron dyed, silk, on very small needles are passed upwards thru the conjunctival flap and the upper edge of the cut conjunctiva, about 5 mm. apart equidistant from the verical meridian. One half of the knot is made with a large loop, the suture being placed to either side by the assistant; the iridectomy and the extraction is then done. In case of threatened or actual prolapse of the vitreous, the sutures are immediately tightened at any stage of the operation, whereupon the vitreous usually recedes into the eye. The suture is then completed by a "granny" knot.

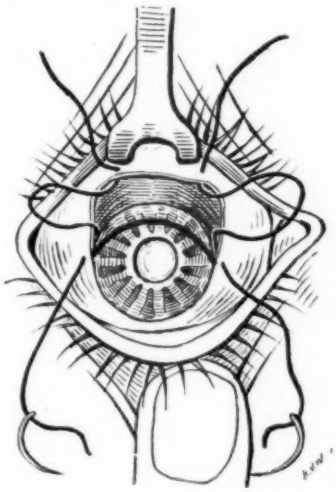

Fig. 5.—Incision made in cornea and sutures placed in conjunctiva, at ends of incision.

This almost invariably becomes untied, being found in the conjunctival sac or on the edges of the eyelids on the occasion of the first dressing, which is usually made on the fifth day. If the sutures have not become loosened they may be allowed to remain for a week or more and are then readily removed by the forceps, as the knots are loose and the thread has to be cut very seldom. No infection of the sutures or the wound has occurred in the author's cases, the patients have never complained of any irritation; in fact, they are seldom aware that the eye has been stitched up.

METHOD No. 2. If the incision has been made thru the cornea, which is very seldom the case in the author's practice the sutures are then placed according to the method of Van Lint; from the conjunctiva at the lower angles of the incision to the upper edge of the cut conjunctiva, 5 mm. apart; the iridectomy and extraction then being proceeded with as in the first instance; the conjunctiva being pulled well down over the wound, in fact covering about one fifth of the cornea. This method was first devised by Van Lint for protection of the corneal wound against infections. The section of the conjunctiva may be made by the scissors before the incision of the globe, and in cases of dislocated lenses the author has usually practiced this procedure.

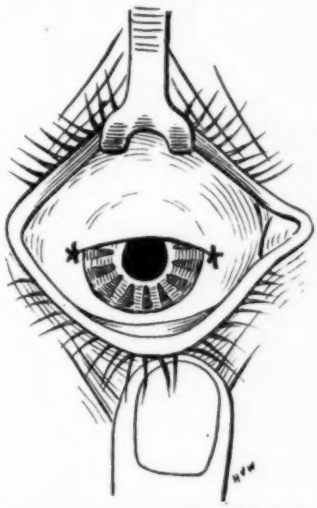

Fig. 6.—Conjunctival sutures tightened at conclusion of operation. Method of Van Lint.

There are certain advantages in closing a cataract incision by suturing. (1) The toilet of the anterior chamber may be more thoroly and satisfactorily made, even after the sutures are fully tied. (2) There is lessened tendency of iris prolapse or loss of vitreous; and if either occurs, the vitreous usually returns into the eye and the prolapse is readily replaced without further loss of vitreous. (3) There is lessened

tendency towards breaking open of the wound with loss of vitreous and iris prolapse, after the patient has been returned from the operating room to his bed. (4) The resultant astigmatism is less than where the wound is permitted to remain open, or rather to coapt by itself. (5) The author feels that percentage of loss of vitreous and of iris prolapse is no more, when the cataract is expressed in the capsule with the conjunctival stitch as a retainer, than when the capsulotomy operation is done. While this has been a routine procedure with him for only two years, he thinks that sewing up of the eye after such major incisions is a safeguard against accidents, occuring both during and after the operation.

ORBITAL CAVERNOUS HEMANGIOMA WITH PULSATING EXOPHTHALMOS. REMOVAL BY ELECTROCOAGULATION.

G. ORAM RING, M. D.

PHILADELPHIA, PA.

An orbital growth, recognized at two years, gradually developed and was removed by repeated chemical cauterization. She was seen when 35, during an attack of influenza. The center of the cornea protruded 17 mm. in advance of the other eye, and was pushed down 10 mm. Ligation of the carotid was followed by lessened distention of the vessels. She returned 5 years later with increased exophthalmos. After electrocoagulation the growth was shelled out with a dull separator. Read before the American Ophthalmological Society, June, 1924.

Early in 1883, the child of two years was examined by the late Dr. Wm. F. Norris, in the Eye Clinic of the University of Pennsylvania. The record indicated the presence of what was regarded as a growth, probably cystic, situated at the upper and inner aspect of the orbit. It was operated upon, the operation being promptly followed by a recurrent swelling which involved the original site and extended downward to the region of the caruncle. There then developed gradually a vascular pendant growth from the caruncle, which was said to have reached the size of an ordinary walnut and which hung down over the lower lid. From this there was more or less constant oozing and occasionally a moderate hemorrhage. This was gradually removed by a local surgeon, thru a series of months by the application of a chemical cauterant. Additionally, there developed thru a period of about thirty years, the condition noted upon admission to the Episcopal Hospital in 1916; the particular reason for her admission being a violent attack of influenza, during which her orbital and ocular symptoms became markedly accentuated and at which time an exposure keratitis threatened the eyeball.

Examination by Dr. A. A. Stevens, of the Medical Staff of the hospital, revealed an extensive pulsating exophthalmos, the proptosis being down and out. The corneal pole was 17 mm. in front of the good eye and 10 mm. below it. The orbit was filled with an extensive vascular growth, extending well beyond the upper and lower orbital margins.

Pressure upon the lids elicited the impression that the orbit was filled with a worm like mass of tense distended vessels. From the mucous membrane near the caruncle, there was frequent oozing and on several occasions a spurt of hemorrhage.

The shock of her father's death which occurred under very tragic circumstances just preceding her admission, it was felt, had figured in the distention picture, as well as the influenza. After a few weeks of local and general treatment the cornea regenerated, and there was a slight recession of the proptosis.

The patient claimed that she had had no examination by an ophthalmologist since childhood. A consultation was then sought with Dr. T. R. Neilson, whose judgment accorded with my own as to the advisability of a ligation of the common carotid artery. This was promptly and skill-

fully done by Dr. Neilson, the scar being visible in the accompanying photographs, numbers one and four.

In addition to the local treatment to the eye and the ligation, the patient was given six injections at intervals of three days each, in the lumbar region, of 10 c.c. of 2% gelatin. A definite recession of the globe followed these procedures, with considerable lessening of the distention of the orbital vessels, especially above. Pressure gave the impression of a softer consistency and the difficulty in lid closure, as well as bruit, promptly disappeared.

Another period of comparative quiet ensued and the patient was not seen again for nearly five years. She then returned with exophthalmos definitely increased from the last record. Further notes of her history show she had suffered the dual shock of the departure overseas of her husband and a severe miscarriage. A third shock still further augmented her oculo-orbital symptoms. Her husband, gassed and shell-shocked, returned to America an entirely changed personality.

The patient's mother, during delirium associated with a nephritic toxemia, struck the proptosed eye; and caused an almost immediate increase in the forward thrust, to a point that made it impossible to close the lids.

The corneal exposure resulted in a keratitis and later in an abscess. Dr. Neilson, who had skilfully ligated the left common carotid artery six years before, was consulted regarding the ligation of the common carotid of the opposite side, and felt with me that the risk was too grave. Ligation within the orbit was not regarded with favor.

The breaking down of the cornea accentuated a situation which had long ago become well nigh intolerable to this young woman. I decided after fully explaining to her the risk involved and having had her full consent, to remove the eye and growth with the aid of an electrothermic method.

Indeed, my especial reason for claiming your attention to the recital of this rare and grave case is the emphasis it gives to a method of procedure whose potency in a variety of ophthalmic and associated lesions has not at all been accorded the important place it deserves in our operative measures.

The presentation of a clinical contribution before this Society may be recalled, in which I utilized the method in removing an enormous recurrent neuroepithelioma with complete orbital evisceration where it was felt that the usual surgical procedure would have meant death upon the operating table. Again in the case here presented, my hospital colleagues expressed the same conviction. This concensus of opinion was shared by the experienced members of the Ophthalmic Section of the College of Physicians, when the young woman was exhibited before that body.

I am in accord with one of the leading exponents of electrothermic surgery in our city, Dr. Wm. L. Clark, in feeling that its sphere of usefulness has lacked proper recognition because of a paucity of authentic literature upon the subject—the lack of emphasis given it in our medical curricula—a prejudice against methods electrical—a lack of standardized and efficient equipment—and finally of a faulty technic.

The aim of these methods is to destroy benign or malignant growths, to seal blood vessels, and to obtain a healing wound with the least amount of cicatrization.

The two tissue changes induced by high frequency currents, according to Dr. Clark, may be classed as; first, desiccation; second, coagulation. In the former the heat is produced by a monopolar current of the Oudin type, a steel needle carrying the current to the lesion. Modern high frequency paraphernalia are compact, not especially expensive and uninfluenced by weather conditions. This current is of high voltage and low amperage. A milliampere meter cannot be used to measure a monopolar current, and the proper strength to be utilized becomes a matter of experience. The current can be delivered thru a short air space and a growth, even on the cornea, can be removed with exceedingly little scarring.

The d'Arsonal current by which coagulation is induced is, on the other hand, of low voltage and high amperage. The current is bipolar, utilizing a multiple spark gap. It is more penetrating and intense; and is used to destroy larger growths, even those involving bone. The active electrode should be pointed.

The effect induced is entirely thermic and the indifferent electrode may be an asbestos pad placed in contact with the patient's back. A meter should be used and the current ranged from 200 to 2,500 milliamperes.

In the case here reported I requested Dr. Clark to apply the coagulation current as demanded. Complete anesthesia was induced by ether. The ether was then removed from the room to prevent possible ignition. When the patient showed signs of regaining consciousness the operation was temporarily discontinued and the ether again applied. Scopolamin and morphin may be used about an hour preceding the operation and less ether will then be required. This was not done in this case, however, as my comparatively infrequent use of this combination has not left me unmindful of the risk involved.

Fig. 1.—Appearance of tumor before operation.

Fig. 2.—Tumor removed by electrocoagulation.

The under surfaces of the lids, both upper and lower, were firmly bound down to the purplish, vascular hypertrophied conjunctiva at the inner third of the eyeball; and as it was deemed necessary to freely expose the growth, the adhesions were incised and the lids freed to the orbital rims. A vertical incision was made from the upper limit of the growth thru each lid and the four half lids were held away from the site of operation, each with a single stitch in the forehead above and in the cheek below. The current was applied by means of a steel needle around the eyeball, and the tissues dehydrated in a series of narrowing circles toward the nerve which was then cut, each insertion resulting in the sealing and destruction of the vessels. The needle was then inserted in several portions of the growth and the lake of blood in each case controlled by the current. An effort was made to preserve the periosteum by keeping the needle a safe distance from the orbital lining. Much harm can be done by an operator who has not had practical knowledge of the subject, as carelessness in the application of the current in this position could easily result in a pene-

tration into any of the nasal accessory sinuses.

It was ultimately possible to shell the growth from the orbit with a dull separator; after incising it at the orbital apex, and controlling the hemorrhage by a final application of the current at this point. The orbit was packed with a bichlorid ointment and the vertically separated lids carefully stitched.

The periosteal lining is now normal in appearance. There is an adhesion at the inner aspect of the lower lid, agglutinating it at this point to the orbital lining. During the process of healing the odor was controlled by hypochlorite dressings.

The eyeball and several portions of the growth were examined at the Pathological Laboratory of Jefferson Medical College by Dr. B. L. Crawford. "Sections from the extraorbital tissue are composed of dense fibrous tissue containing many large and small spaces, the majority of which are filled with blood. In places there is considerable inflammatory reaction thruout the tissue, and the connective tissue seems to have undergone a hyaline change in small areas. Diagnosis: Cavernous hemangioma."

Fig. 3.—Scarring of lids after operation.

Fig. 4.—Final result.

NOTES, CASES, INSTRUMENTS

CATARACT FOLLOWING ELECTRIC SHOCK.

WM. EVANS BRUNER, A.M., M.D.

CLEVELAND, OHIO.

Cataract following electric shock is sufficiently rare to warrant reporting the following case:

Mr. G. R., age 27, was brought to us June 14, 1922, with the history that on October 21, 1920, he came into contact with a high tension wire (about 22,500 volts). He was knocked unconscious, was burned about the head and face and also about the feet, so that in consequence he lost nearly all his toes. About eight or ten weeks later he noticed that he could not see well, and his vision continued gradually to fail until he had only light perception. He had previously had good eyes and had never worn glasses. His general health is good tho he still feels somewhat the effect of the shock in the general condition of his nerves.

Examination showed moderate conjunctival injection, pupils were equal and prompt to light. Light perception, fields and projection were normal, in each eye. In the right eye the entire lens was white, tho not entirely uniform; with some small irregular spots, more densely white, on the anterior capsule near the center of the pupillary area. The left eye showed the same condition, tho the cataract was possibly not quite so dense. The cataracts probably were rather soft. He was told of the possibility of some disturbance of the deeper structures, but an operation was advised. A complete general examination revealed nothing which might have any bearing upon the eye condition.

He was sent to Lakeside Hospital on the 19th, and two days later a linear extraction was done upon the right eye. An incision was made with keratome, capsule opened with cystitome and the lens thoroly stirred. It was then removed, partly by stroking the cornea with counter pressure on the upper lip of the wound, and partly by irrigation. On July 5 a similar linear extraction was done on the left eye. Recovery was uneventful and uninterrupted. We gave him temporary glasses July 20; the pupillary area in each eye was clear, but a little capsule could be seen in the periphery. The vitreous was clear in each eye and the fundus showed nothing pathologic. On August 30, he was given permanent glasses as follows:

R.+11.00⌒+2.00 c. ax. 45° V.=5/4
L.+ 8.00⌒+6.50 c. ax. 165° V.=5/6

Plus 3.00 bifocal was added, with which he read .50 print very readily at the normal reading distance.

When last seen November 10th, 1922, the eyes were in similar excellent condition.

TRAUMATIC ANIRIDIA.

JOHN R. ROGERS, M.D., F.A.C.S.

GRAND RAPIDS, MICH.

Believing that the complete loss of the iris thru violence is a comparatively rare accident, I venture to report the following case:

P. W., employed as a car painter. On May 13 he was struck across the left eye by the handle of a refrigerator car; the blow breaking the lens of his spectacles and driving pieces of glass against the eyeball. He was seen at my office within an hour of the accident.

The first examination showed a small cut on the skin of the upper lid and a large transverse incised wound of the cornea, extending from the limbus to the median line on the temporal side, but somewhat below the center. There was also a tear of the conjunctiva, being a continuation of the corneal wound. The anterior chamber was black and filled with newly extravasated blood. The corneal wound showed no hernia of the iris. A considerable number of small pieces of glass were picked out of the conjunctival sac, but no foreign body could be seen in the anterior chamber. The patient was sent to the hospital where iced compresses, atropin and rest were ordered. He was slightly nauseated and weak, but did not suffer extremely.

He was seen daily after this revealing, as the blood in anterior chamber was absorbed, an entire absence of the iris.

At present the ocular media are clear, the entire circumference of the lens is visible, the lens is not dislocated, and the ora serrata is distinctly made out. Save for a minute amount of pigmented substance at the site of the wound no vestige of the iris can be seen.

The refraction and the fundus condition of the eye are about the same as of the uninjured eye. R.—3.⌒—.50 c. ax. 180°=6/6. L.—3.⌒—.75 c. ax. 180°=6/9.

At present the patient is wearing his correction, with the left lens a No. 3 Crookes. He complains of dazzling in the injured eye, and of double vision. This is a homonymous diplopia which seems to be slowly improving, but he is not able to resume his work on account of confused vision.

It is to be presumed that the iris was expelled from the eye thru the wound, at the time of the accident, by the force of the blow.

The external appearance of the eye is rather striking, the entire front being black, in contrast with the uninjured eye which is a light gray, blue. The patient has made an uninterrupted recovery, and the only traces of the injury are the absence of the iris, a small linear scar of the cornea and a small cystic scar of the conjunctiva at the outer canthus.

Fig. 1.—Traumatic aniridia of left eye.

July 21. A later examination shows no actual diplopia except with the red glass when a homonymous diplopia of 4° becomes apparent.

Vision of left eye with correction is 20/40. The patient has resumed his work on part time, working three days a week; but complains of the injured eye aching at the close of the day's work.

SOCIETY PROCEEDINGS

Reports for this department should be sent at the earliest date practicable to Dr. Harry S. Gradle, 22 E. Washington St., Chicago, Illinois. These reports should present briefly scientific papers and discussions, include date of the meeting and should be signed by the Reporter or Secretary. Complete papers should not be included in such reports; but should be promptly sent to the Editor as read before the Society.

ROYAL SOCIETY OF MEDICINE. SECTION OF OPHTHALMOLOGY.

October 11, 1924.

SIR ARNOLD LAWSON, K. B. E., Pres.

Hole in the Optic Disc.

MR. RAYNER BATTEN showed a patient with a peculiar appearance in the optic disc, which might be due to either a swelling or a depression. It was situated behind the scleral ring. Possibly it might be a clear walled cyst.

THE PRESIDENT's view was that it was a hole, with a vessel running across the bottom of it. There was a strong parallax.

MR. TREACHER COLLINS thought it might be a crater like depression filled with neuroglial tissue, such as described by Coats.

MR. JULER agreed with the President's view, and referred to the findings of Mr. Coats in his cases.

Tints and Their Values.

SIR ARNOLD LAWSON then delivered his *Presidential Address*. He said the subject of tints had become a somewhat prominent one recently, and much had been written—some reasonably, some unreasonably—about the destructive effects of ultraviolet rays on human eyes. Owing largely to alarums, for which the optical trade was responsible, the public seemed to have become largely imbued with a haunting fear of daylight, so that a large body of healthy people were wearing tinted glasses for protection. These glasses seemed to Sir Arnold to have been prescribed in an indiscriminate and indefinite way.

Assuming the wave theory of light to be correct, it was known that the visible spectrum extended from waves of light of 700 at the red end to 400 at the violet end. The infrared rays could pass into the eye unimpeded, and the ultraviolet rays caused harmful chemical action. The eye possessed no direct protection from the luminous and infrared rays, but Nature provided a good deal of protection against the ultraviolet rays. Experiment showed that this protection was furnished by the cornea and the crystalline lens, especially the lens; the cornea absorbed all waves of shorter length than about 290 while the lens was impervious to ultraviolet rays of shorter wave length than 350. In the laboratory the ultraviolet radiation had been traced to waves of about 20, hence only a very small proportion of possible ultraviolet radiation could possibly reach the retina normally. And ordinary sunlight at low altitudes was rather poor in ultraviolet rays; it contained few of shorter wave length than 350. Also, protection from the heat radiation at the red end was to some extent afforded by the absorptive properties of the pigment lining the back of the iris and choroid, and by the pupil's power of contraction. In all human races the eye was self adapted to endure without harm the sunlight of the particular part of the world they lived in. Hence healthy eyes, in ordinary circumstances, did not need protection by tints.

The situation was, however, somewhat complicated by various subsidiary factors, the most important being (1) the intensity of the light, (2) the duration of the exposure, (3) the presence of glare, (4) occupation or trade.

With regard to the first, extreme degrees of sunlight, especially in the rarefied atmosphere of mountains, are abnormally charged with ultraviolet and infrared radiations, and this implies an increased dosage. The chief danger from the eye experiencing intense sunlight seemed to be from the red and not from the violet end of the spectrum.

Concerning the duration of the exposure, under certain conditions of health, prolonged exposure to even

moderate degrees of light may be harmful, due to a lowering of the natural resistance.

As to glare, this may considerably complicate the patient's problem. Glare was the unpleasant effect caused by excessive reflection from below. Usually glare proceeded from snow, desert sand, rock, water, or chalk. The light, in glare, struck the eye in an unaccustomed manner, and it was something beyond normal experience. Snow reflected about 70% of the existing sunlight and snow enabled the effects of intense light even when the direct sunlight was of but moderate intensity. The effects of glare were exerted in the luminous and infrared regions of the spectrum rather than in the ultraviolet; hence it was reasonable to consider snow blindness as due not so much to excess of ultraviolet radiation as to excess of exposure to the luminous and infrared radiations. The conjunctivitis accompanying snow blindness was probably due to sunburn of the conjunctiva.

Dealing with the effects of occupation, he said that such trades as acetylene welding exposed the worker to intense ultraviolet radiation; and, on the other hand, glass blowers and workers in foundries were subjected to excessive heat radiation.

Sir Arnold then passed to a consideration of the spectroscopic values of various *tinted glasses.* For this study, he selected London smoke No. 3, three shades of amber, five shades of Fieuzal, Crookes' A, A2, B, B2, and Peacock Blue. All the glasses so tested were of 2 mm. thickness, except that Peacock Blue was examined in thicknesses of 5 and 2 mm. Thickness of glass was a most important point.

The experiments were arranged by Mr. Hamblin and the spectroscopic photographs he was showing were executed by Dr. Judd Lewis, Professor of Physics at University College. These latter were embodied in a chart shown.

With regard to ultraviolet radiation, the greatest absorptive power was noted from the darker Fieuzal tints, while the Peacock Blue and the Crookes' glass produced much the same effect. Next in order came amber shades, and the least protective was No. 3 shade of London smoke. All the Crookes shades had practically the same absorptive power, and none of the Crookes' shades protected the eye against wave lengths shorter than 350. The only tints which cut off all ultraviolet radiation were the darker shades of Fieuzal. For acetylene welding the darker shades of Fieuzal were much better than Crookes' glass, and in high altitudes and for snow blindness nothing gave so much protection and comfort as Fieuzal 4 and 5 or Peacock Blue.

Concerning red and infrared radiation, the Peacock Blue was by far the most effective, especially when 2 mm. thick, next in order being Crookes' B2 and Fieuzal 4 and 5. The various shades of amber were less effective than the corresponding shades of Fieuzal, and less so than a medium shade of London smoke or Crookes' B2.

All the various kinds of tint were equally effective in generally diminishing the luminous spectrum. Prescribers of tints should always pay special attention to the thickness of the tinted glass. Another series of photographs were taken showing the absorption of the tints when of only .05 mm. thickness. The absorption effect, in the case of the thin glass, was greatly lessened. A glass of less than 2 mm. thickness was likely to produce an effect considerably less than was expected. This consideration was of special value when ordering a tint without any incorporated lens and when ordering a tint to be overlaid on a minus lens. In these circumstances it was well to specify the thickness of glass to be employed. It would be well if some scientific body, such as this Section, could agree on uniformity of glass for prescriptions for these tints. No such uniformity existed at the present time.

He then passed to a consideration of the adaptation of these principles to the wearing of tints in health and disease.

Under ordinary circumstances, protection by ultraviolet glasses was quite unnecessary. When extraordinary cir-

cumstances were apt to be encountered, the two main factors to be considered were the luminous and the heat radiations, rather than the ultraviolet. In high sunlight and glare, the darker shades of Fieuzal were much more effective than Crookes' glass, and for extreme cases Peacock Blue was the most satisfactory. Artificial light was not stronger in ultraviolet radiation than was sunlight. Dr. Leonard Hill recently stated that in the case of an oil lamp, 97% of the energy was in the infrared region, and of electric incandescent lamp, 95%. Crookes' A or A2 glass had the superiority that it afforded a general shade without materially disfiguring the appearance or altering color values. There were many people with quite healthy eyes who were, however, physically or mentally abnormal. Often in physical disease and neurasthenia the general function of the eyes was impaired, and in these, help was needed. Smoked glass was still as valuable as ever, but it was somewhat depressing, and Fieuzal did not so much interfere with the color scheme and was as effective as smoked glass in other respects. The wearing of tints was apt to become a habit, and to thus lead to inability to endure bright light unaided.

With regard to wearing tints in disease and as a prophylactic against disease, it had been shown that cataract due to glassblowing was due to harmful infrared radiation, not to the effect of ultraviolet rays. The best prophylactic tints were Fieuzal 4 or 5 and Peacock Blue. In all cases of cataract tinted glasses should be worn in bright sunlight or glare. Glare by artificial light should be shunned as much as glare in sunlight. He often ordered two degrees of shade: one for moderate, the other for extreme degrees of light. After the extraction of cataract, the eye was deprived of its most powerful factor of protection against ultraviolet radiation. All aphakic patients should wear some protective tint out of doors, except on dark and cloudy days. In active inflammatory disease of retina and choroid he always ordered Peacock Blue, which cut off all infrared radiations, and most of the yellow and orange also. It had a very soothing effect on the patient.

Discussion. MR. HAROLD GRIMSDALE, in proposing a vote of thanks to the President for his address, said he thought a further use of tinted glass was to be found in the case of people towards middle life who manifested Pulfrich's phenomenon. That authority showed, by a series of experiments, that the perception of a stimulus varied with the intensity of the stimulus, therefore if by any means the stimulus reaching one eye was weakened, as by putting tinted glass in front of it, the position of a moving object was falsely projected. Some people, for this reason, found a difficulty in exactly timing their strokes in sport. Sometimes after retrobulbar neuritis, altho the form perception had been recovered, the light perception had been somewhat reduced, and a moving object was seen in the wrong position.

MR. ERNEST CLARKE referred to the early electric light with the carbon point, and the glare produced; and mentioned with satisfaction the present practice in many buildings of brightly illuminating a white ceiling, and allowing the hall to be served by a soft diffused light. A great point about Crookes' glass was that it did not cut off luminous rays. He agreed that patients should not be too ready to listen to advertising people on this subject.

MR. MALCOLM HEPBURN said he had found that the wearing of Peacock Blue glasses on mountain climbing expeditions was not comfortable; the glasses had to be worn the whole time, whether one was climbing rock or snow, and differentiation was so difficult that a false step was easy. Green was preferable for these conditions.

MR. G. H. POOLEY (Sheffield) agreed that among furnacemen the wearing of Peacock Blue glasses seemed a source of great comfort, and they certainly enabled the work to be done efficiently. In the North of England it was found that optical testers were ordering Crookes' glasses in a wholesale fashion, with no such reasons as actuated the medical man, and the public felt that the extra price betokened out-

standing merit. Healthy people with normally healthy eyes resorting to tinted glasses was a thing the profession should set themselves to discourage. He did not think it had been substantiated that infrared rays caused any definite changes in the lens.

MR. BERNARD CRIDLAND (Wolverhampton) said he understood from the manufacturers of Crookes glass that the tint had little to do with its optical properties, and that the tint was added because otherwise the public would not think the price was justifiable.

MR. CYRIL WALKER (Bristol) referred to the success of smoky amber colored glasses in the case of a friend in Labrador; these enabled him to hunt and shoot without discomfort.

MR. TREACHER COLLINS had a word of praise for amber tinted glasses, following upon his own use of them. When people who came to him were likely to be exposed to ultraviolet rays he ordered for them amber colored glasses. One went to Tibet, and when he came back he said the rest of the party had snow blindness, but he, having worn the glasses, was immune. He agreed that cooks and others exposed to heat derived relief from wearing Peacock Blue glasses. He would like the President to extend his researches to pebbles.

MR. A. D. GRIFFITH thought the chief value of Crookes' A glass was in its absorption of the yellow band, by which the luminosity was reduced; this was the center of the diffraction spectrum, and was the region of greatest luminosity.

Cataract Operations in Egypt.

DR. A. F. MACCALLAN read a paper giving his experiences in ophthalmic practice in Egypt, in which he discussed the various operations, and his own general procedure.

NETHERLANDS OPHTHALMOLOGICAL SOCIETY.

Utrecht, May 28, 1922.

Translated by E. E. BLAAUW, M. D.

Exudative Iridocyclitis in a Calf.

G. TEN DOESSCHATE had received the specimens and photographs of the calf's eyes from Prof. Jakob, demonstrated by him as well authenticated congenital ocular inflammations of a rare type. The animal showed these deviations at birth, was healthy otherwise and was killed when 5 days old. Both eyes, of normal size, showed exudative iridocyclitis. The anterior chamber contained a movable fibrin clot (1.29—0.69 and 0.72—0.72 cm.), a small exudation in the vitreous and the retina. Microbes could not be demonstrated. The posterior surface of the iris was covered with a thick fibrin layer. Probably the infection was hematogenous as the eyes did not show external inflammation.

Discussion. PROF. VAN DER HOEVE stated that intrauterine inflammations are known.

Cause of Red Reflex from Normal Eye.

E. MARX referred to his previous publication in which he stated that the retinal pigment in the normal, well pigmented eye is to be considered exclusively responsible for the red glare, and not the red color of the blood in the choroid. On spectroscopic analysis, the light which returns from the eye has no hemoglobin or oxyhemoglobin rays. One observes obscuration in the yellow, much absorption in the yellow and violet, with some absorption in the green. On the contrary, in the light from an albinotic eye, the rays from the blood are clearly seen. Furthermore the pigment of the choroid and the retina is red, when illuminated by strong white light; and it gives, ultramicroscopically, a distinct red reflex. An enucleated, bloodless eye shows the same red color as the normal eye.

At that time, Marx had been unable to give a definite proof, consisting in producing the red reflex from an eye, which has remained in its place but had been exsanguinated. The blood in the choroid and retina must first be replaced by water and then by a colored fluid, preferably by a color which is striking, if the pigment epithelium is to let it pass during ophthalmoscopy or illumination of the eye. The right cavity of the heart of a rabbit was opened and the blood washed out with

physiologic salt solution. This was followed by about a liter of freshly prepared Prussian blue solution. During this manipulation, the eye was observed ophthalmoscopically and the color of the fundus found to be unchanged, while the retinal vessels took a color corresponding to the fluid which passed thru them.

Directly after the perfusion with Prussian blue, the eye was enucleated and observed with transmitted light; which allowed more exact judgment, as the light had to penetrate the sclera and choroid (both having blue vessels) before being filtered by the pigment epithelium. With this diascleral illumination, the eye whose uvea was full of blue vessels, did pass other than red light. After this had been observed by various people, the choroid was detached from the sclera and cut up in pieces some with, some without pigment epithelium. Under the microscope the vessels were free from red globules; and, as far as visible, were filled with blue color. Even the few scleral vessels did not contain any red. The same results were obtained from a slightly macerated fetus of 7 months; where the injection was done thru the carotid. With diascleral illumination, the eye was red. The choroid was spread on a glass slide, and red globules could not be found in any vessel. The injected eye of the rabbit was photographed with X-rays: the eye was entirely opaque for these rays, and was therefore entirely filled with a substance (Prussian blue) which stopped the X-rays.

MARX thinks, therefore, that the red color from the ocular fundus, which is normally pigmented, cannot be attributed to the choroidal blood, but to the retinal pigment.

Discussion. WEVE thought that Marx gave too large a rôle to the pigment and he did not consider the absence of absorption lines conclusive.

MARX stated that the fundus looks red in rabbits injected with blue fluid notwithstanding the blue retinal vessels. In albinos, the absorption lines for hemoglobin and oxyhemoglobin are found. His experiments were confined to eyes of normal pigmented epithelium.

Glioma of Retina.

T. W. SYPKENS (Utrecht) showed an eyeball which was removed for hyalitis and contained a glioma of the retina. The entire globe up to the lens was filled with a necrotic tumor mass. Some metastases were found on the posterior corneal surface. Then the exenterated recurrence was demonstrated, showing the freedom of the optic nerve in the large gliomatous mass. The specimens after autopsy, the second recurrence in the orbit, destruction of the cerebral base, and the second eye were also shown. The latter had a slight papilledema and directly behind the eyeball, a gliomatous mass, which came from the cerebral cavity into the orbit.

A Case of Phacocele.

SYPKENS showed this and the following three specimens. A perforated hypopion ulcer that held a peculiar dirty-brown knob the size of a hailstone. Microscopically it appeared to be the prolapsed lens. Its largest part was still in the eye and owing to the perforation it resembled a dumbbell. This condition must have lasted at least 24 hours, without the lens having suffered. No cataractous changes were found. The lens capsule was well preserved, and seemed only to have ruptured during manipulation. The case is considered very rare.

Staphyloma of Cornea.

Three to five years ago following injury, a corneal ulcer perforated, healing with leucoma. Enucleation was done on account of a large staphyloma, which interfered with closure of the lids. The corneal epithelium was changed to skin with papillary formation, distinct stratum granulosum and marked cornification. Various small vessels in the "subcutaneous" tissue with thickened hyalin walls.

"Phakitis" with Hematoma Lentis.

After injury with a sharp object and healing with anterior synechia, the eye was excised on account of persistent irritability. Besides an organizing mass on the iris, in the ciliary body, and between this and the lens, covering half of the posterior surface, was a typical infiltration from the anterior

pole, via the equator to near the posterior pole. There was distinct extension between the lenticular lamellae. The posterior lens capsule was perforated, with curling margins which made an opening for the protuberant mass. Quite a quantity of blood, a true hematoma, existed below the anterior capsule, surrounded by the described infiltration. Sypkens thought that the sharp object after penetration of the cornea went thru the iris into the lens, carrying infective organisms. These produced the infiltrations, which came from the iris. This infiltration later broke thru the posterior capsule. Thru an injured iris vessel, blood was extravasated, and this penetrated into the lens thru the wound in the capsule. He was unable to locate the wound in the anterior capsule.

Secondary Buphthalmos with Peculiar Topographic Relations.

This specimen came from injury in a young child. Increase of tension produced staphyloma and enlargement of the juvenile eyeball. Behind a very deep anterior chamber a maximal extended "iris" became visible, and in its center, a small lens grown together to one surface, while the true iris had formed the staphyloma with the cornea. From the strongly pigmented second iris, strands went out to the posterior side of the staphyloma. The second iris presented itself as a surface, the external half of which was pigmented, and its internal half around the lens white. The second iris appeared microscopically to be the extended ciliary body, which formed the diaphragm thru organized inflammatory exudate, which had grown together with the lens. The strands of the second iris toward the staphyloma could be explained thru retraction of the original adhesions. A distinct structure, which could be demonstrated as a descent from iris tissue, or organized exudate could not be recognized. The disc was deeply excavated.

Technic of Dacryocystorhinostomy.

H. WEVE presented a paper on this subject.

Discussion. DE KLEIN mentioned that a slit canaliculus does not need to be a contraindication, as a simple way of closing the canaliculus has been advocated lately from America and by Benjamins and van Romunde.

MARX advised passing a probe thru the upper punctum during the operation, and had tried unsuccessfully the suture of Dupuy-Dutemps.

VISSER asked in how far ozena influenced the condition.

ZEEMAN rather liked to use the needle holder, which is used for the cleft palate, for the sutures of Dupuy-Dutemps.

ROCHAT referred to the many good results with the operation of West.

VAN DER HOEVE has seen a good result from the operation of Gutwart, which does not leave any scar.

WEVE replied that a keloid seen by him had disappeared after half a year.

TOTI had the same experience. With ozena he never operated. But he did with tuberculosis and trachoma; here the operation takes the character of that ascribed to Blaskovics. The advantages over the West operation are, the easy manipulation even with a narrow nasal passage, better anesthesia; and, after failure, the condition is present as after extirpation of the lacrimal sac while after an unsuccessful West operation the secretion remains. The drill is more agreeable for the patients than the chisel, but with the drill it is more difficult to leave intact the nasal mucous periosteal flap.

Action of the Ocular Muscles.

J. VAN DER HOEVE asserted that the action of the ocular muscles is much more complicated than often supposed. The simplest motion is out from the primary position in the horizontal meridian. Bad results follow if incorrect notions are made the basis for operative intervention. The method of Pflügk and, independent of him, of Dantelle, from concomitant strabismus in the horizontal meridian, are based on such simple representation. Both authors think that if, with concomitant strabismus, the internal and external recti are loosened from the eyeball it is corrected. Then these muscles are attached to the bulb, as much forward or backward from the

old insertion as the globe is turned, so that the new insertion takes the same place in the space as did the old and, therefore, the distance between insertion and origin of the muscle remains as before the operation.

Van der Hoeve demonstrated that this is not so, because altho the anatomic relations for the internus and externus remain for movements in the horizontal meridian as before the operation, these have changed for all other ocular muscles; while for fixation downward, as in reading and writing, the anatomic relation for internus and externus appear to have been considerably changed. Here the internus is not simply adductor but also rotator and depressor; the externus not simply an abductor. The operation changes this downward turning power of the externus and internus for the adducted muscle, this downward turning power has been much increased, or decreased for that transplanted posteriorly. The proposition of von Pflügk and Dantelle therefore is not applicable, and one sees that the theoretic representation of the action of the ocular muscles can have practical value.

Van der Hoeve here developed his viewpoint regarding the complex action of the ocular muscles, which has appeared in the literature. He demonstrated this with the elaborate scheme of Marquez. Any operation on these muscles is so gross, that only a control for the ocular position can produce the desired results. This control is for sharp sight where the visual line is directed at the fixed point; the aversion of the visual organ for torsion of the vertical meridian (cylophobia) and during binocular vision the abhorence for double images (diplophobia). As soon as one of these three conditions for easy vision is not fulfilled, this control mechanism informs the higher centers; and the motor mechanism is put into action to remove the fault in the ocular position. If only one adductor, one abductor, one levator and one depressor were present; every motion, apart from the strictly horizontal and vertical, from the primary position would produce torsion and, teleologically considered, it would seem much more probable, that as the recti produce the necessary voluntary motions, the obliques serve to compensate as much as possible the unwished for torsion.

Statistics of Glaucoma Operations.

R. T. BRANBERGEN presented a paper on this subject.

Discussion. ROCHAT stated that one should not speak of a true cure, altho retardation is sometimes observed, and referred to Tresling's communication from his clinic. He thinks that with absolute glaucoma an operation should be done, as it quite often has good results.

PIEKEMA agreed as to the incurability of glaucoma and the operability of absolute glaucoma.

VAN DER HOEVE wished to operate on absolute glaucoma, before an artificial eye was made necessary. He thinks that the postoperative infections after trephining, of some German statistics, are due to faulty technic.

BRANBERGEN replied, that for comparison of the different operations an equal time of observation should be taken. Therefore he took the condition after one year; and talked of a favorable result if, at that time vision, visual field, tension, etc., did not show a decline. If the observation time is taken longer, the number of successful cases is naturally smaller. So for trephining the percentage of the successes after 3 years falls to 30. The numbers for longer observation he did not give to avoid becoming too prolix; the totals became too small for computations; and also, because his given numbers demonstrate with great clearness the excellence of trephining over iridectomy.

Tuberculosis or Glioma.

T. W. SYPKENS (Utrecht) mentioned the known difficulties for the differential diagnosis between tuberculosis and glioma, or other pathologic processes in the eye in youth. He wished to confine himself to the difficulties, which originate when a glioma retinae progresses to the anterior part of the eyeball and especially when there arises the picture of the socalled nodular iritis (Krückmann). He observed a patient with a one sided cat-

aract of obscure origin, in whom later developed a typical nodular iritis. The iris was strewn with greyish-white dull and glassy spots, and points without any blood vessel formation or other inflammatory symptoms. There was a distinct descemetitis present. The rest of the eye was quiet. A developing increase in tension suggested the possibility of a tumor. The eye was excised by Professor Snellen.

Macroscopically a funnel like, brittle mass, was seen around the disc, thru strands connected with the anterior part of the bulb. Microscopically a typical glioma retinae was present, extending onto the ciliary body and the lens capsule with metastases on and in the choroid, on the posterior and anterior surfaces of the lens and on Descemet's membrane. The only sign of inflammation was a new formed, small, connective tissue layer, on the anterior surface of the iris. The chamber angle was closed. The clinical picture had become clear. Sypkens compared his case with those of Jung, Weekers, Behr and Meisner, and demonstrated microscopic specimens and pictures. He mentioned also the possibility of extirpating an eye for glioma, where no glioma was found; and he demonstrated with a case, where an exudative "choroiditis" was found. The following considerations can be of importance in making a differential diagnosis between glioma and tuberculosis in children.

The anamnesis in patient or family, degree of irritation, inflammatory symptoms, tension, and the very rare occurrence in early, youth of "nodular iritis," in children should point more toward glioma than to tuberculosis. (Meisner.) The color of the knobs in glioma are mostly grayish-white, dull or glassy, sometimes yellowish. In glioma no vascularization in, on, or around the knobs is present. The color of the hypopion is greyish-white in glioma. When iris knobs are removed with the current in operative intervention, the diagnosis points toward glioma. Symptoms in the lens, and especially on the anterior capsule, should be looked for.

Discussion. Rochat mentioned that a large tumor mass was found in the spinal canal, which had pressed on the side of the entire cord, without producing symptoms, at the autopsy of an infant dead from glioma. He advised the examination of the spinal canal in gliomatous patients.

Van der Hoeve mentioned, as bearing on the difficulty of diagnosis, a case recently reported by Meisner. The diagnosis was orbital tumor. After a Kroenlein operation a tumor was found originating from the ethmoid. Macroscopic diagnosis, carcinoma, microscopic, round cell sarcoma. The orbit was eviscerated with removal of ethmoid and sphenoid to the dura mater. Microscopically tuberculosis was found.

Glioma Retinae and its Treatment.

E. Marx reported on a 2 year old child, who was brought to the Leiden dispensary with the left eye red and swollen for 2 days. The left eye had always been brown and the right eye, blue. Patient had been free up to that time from eye trouble. The eyelids showed a marked edema, especially the upper lid, red and swollen. The conjunctiva was chemotic and protruded between the lids, the cornea somewhat dull, pupil artificially dilated, iris blood red. Around the pupil a broad black margin was present. There were opacities in the pupillary space, and in the pupil a yellowish-red reflex; ocular movements restricted, tension diminished. The chemosis was much less two days later and after 4 days, the motility of the eyeball was restored and the chemosis almost gone. The pupil was fully dilated and small bloodclots were present at the margin, toward the temporal side. There was a deep opacity in the cornea, and a slight superficial shagreen was seen. A red reflex came from the fundus and the anterior chamber showed the same color. After a week the eye was white, and the tension decreasing. The child was discharged but returned after a week with some photophobia (especially in the morning) and rise of temperature, which were ascribed to an existing whooping cough. The red fundus reflex was still present with blood in the anterior chamber. For the first time in the right eye, a greyish reflex was seen, and after dilation,

a large grey tumor became visible in the vitreous toward the nose upward. The retinal vessels were not widened and coursed over the movable tumor mass. Internal rhinologic examination and X-ray negative. Glioma was suspected and the blind left eye removed. A 2 mm. opening was burned in the thick sclera and cultures taken from the contents. The different media remained sterile.

Irradiation of the right eye began on October 13. First series to the end of October 170,000 volt, 2 ma. and 1/5 mm. zinc filter at 30 cm. distance, covering 60 minutes. The child returned a month later and the change was remarkable. The fundus reflex had disappeared and ophthalmoscopically a grey tumor, without vessels, was found. However, some slightly colored loose flakes were suspended in the vitreous. A second irradiation, similar to the first was given, from December 7 to 21, of 100 minutes. After a month the fundus picture did not differ much from the last, the tumor remained apparently unchanged but the opacities in the vitreous had increased. Therefore, from January 24 to February 7 and from March 14 to 23 irradiation of 150 minutes with a 200,000 volt, 2 ma. and 0.8 ma., copper filter at 30 cm. distance, was given.

During the treatment the tumor grew, the vessels which went from the tumor toward the iris became thicker, the vitreous opacities became larger and more numerous. So the radiologist, Dr. Steenhuis, again on March 27 and April 1, irradiated the right side of the face for 90 minutes; and on April 11 the left side for 60 minutes with quantities as above. On May 1st the tumor had increased extending more to the temporal side, more seedlings had appeared in the vitreous and a small tumor was seen at the temporal papillary margin. The irradiations were discontinued on May 15. At the beginning of July the eye had become practically blind and was enucleated.

The eye was soft and slightly shrunken. Meller and Hirschberg's dictum, that beginning glioma cannot be overlooked because its vessels are always tortuous and thickened, did not hold in this case.

The sclera of the somewhat shrunken eyeball was 3 mm. thick in its posterior part. The contents of the globe was a greyish crumbling mass. The softness of the eye did not seem to be preceded by a glaucomatous condition. Histologically the sclera was thickened thru increase in numbers of fibrillae which were more winding than usual and the tissue contained more nuclei than normal. The perichoroidal cavity was strongly distended, with many enlarged vessels containing a 3 by 1.5 mm. spindle shaped strip of living tumor tissue partly penetrating the sclera, apparently without tendency to further penetration. This tumor contained cells of different form with large nuclei, and multiple mitoses. The formalin fixation and Van Gieson stain prevented the determination of astrocytes. Still the diagnosis pointed to glioma, altho distinct rosettes were absent. A direct communication from the retina to the choroid seemed probable, as the glass membrane had disappeared in most places. Of the retinal tissue only the here and there strongly and irregularly proliferated pigment epithelium remained; which however was absent in the neighborhood of the tumor. The mass, which had taken the place of the vitreous was dead gliomatous tissue, in which the typical tumor formation around the vessels could be distinctly seen, altho the vessels walls had vanished. In this necrotic tissue, the regressive metamorphosis of the nuclei showed pycnosis, but not as much as Leber reported. Karyolysis and nuclear wall hyperchromatosis were found. A small, thick tissue mass, probably not one mm. thick had penetrated the optic nerve.

A somewhat shrunken globe which contained a compact living tumor mass was found. This rapidly necrotic gliomatous degeneration must have produced an excessive production of toxins, which irritated the eye and its surroundings, and explains the dilated choroidal vessels and the excessive thickness of the sclera, the impaired motility of the eyeball, the chemosis and swollen eyelids. Altho the results of radiation were not very beneficial, the treatment was continued.

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EPITHELIAL PARASITISM AND PHAGOCYTOSIS.

The epoch making discovery of Lindner, that the bacteria which cause conjunctivitis are epithelial parasites, is now adequately set forth in English by Dr. Howard. With it is presented, for the first time, Howard's equally startling observation, that under the stimulus of emergency, the younger epithelial cells of the conjunctiva become phagocytes; and ingest and destroy the invading bacteria, assuming a function hitherto recognized as chiefly belonging to leucocytes.

We must call attention to the enormous scientific importance of these discoveries; and at the same time, point out that the brief paper by Finnoff shows a practical way, for every one who uses a microscope, to confirm these significant observations, and apply the new knowledge to the earlier, more accurate and more complete diagnosis of conjunctivitis.

It cannot be too strongly emphasized that the present generation of ophthalmologists is witnessing the dawn of scientific medicine and particularly of scientific ophthalmology. Men now living can remember the time before the use of the ophthalmoscope and before the scientific study and appreciation of the anomalies of refraction. It was in 1837 that Schleiden and Schwann, dining together, discussed the nuclei of vegetable and animal cells. Two years later, the latter published his cell theory, making the cell the biologic unit. In 1842 Bowman began his series of remarkable contributions to the microscopic anatomy and physiology of the human body. In 1858 Virchow published his "cellular pathology" culminating in the motto "Omnis cellula e cellula", carrying into new knowledge Harvey's celebrated proclamation, "Omne vivum ex ovo".

Pasteur, who had shown that microorganisms cause fermentation and putrefaction, proved that they also cause disease, that of silkworms (1870), and anthrax (1877). The investigators that followed Pasteur soon made it clear that disease was a warfare of cells, carried on by toxins and antitoxins, opsonins and phagocytosis. Metchnikoff (1892) showed that certain wandering cells, especially leucocytes, and certain fixed cells, including some in the spleen pulp, lymph glands, neurolgia cells, connective tissue cells, nerve cells and endothelial cells possess the power to ingest, kill and dissolve bacteria.

The protective office of the epithelium had been recognized; but was conceived of as simply mechanical. Lindner has shown us in detail just how, in the conjunctiva, it performed this function. The bacteria establish themselves on the epithelial cells of the superficial layers, which are still nourished thru the vessels and lymph streams beneath. From these cells, the bacteria draw nutriment, living as true parasites. They rapidly multiply, forming a thick coating, well compared to turf. Then gradually, the bacterial secretions loosen the layers beneath, and the colonies of organisms extend to layers less superficial.

But the bacterial poisons, spreading to the deeper layers of epithelial cells, arouse them to rapid proliferation. These deeper layers rapidly thicken until the more superficial cells, carrying their bacterial turf, are thrown off. Meanwhile, the young epithelial cells that replace them are endowed with a certain immunity. They are not favorable hosts for the invading bacteria; and as Howard shows they become phagocytes devouring, killing and digesting the bacteria.

These are the general, fundamental facts of the acute, bacterial inflammations of the conjunctiva. The details of this cell warfare, the exact picture it presents at various stages, the relative shares that various processes take in it, vary with the bacterial aggressor, the age, state of health of the patient, and the individual immunity possessed by the conjunctiva attacked. But the underlying process, above outlined, is going on in some part of the conjunctiva in every case. With this clearer understanding of the methods of attack and defense, we should soon become better able to interfere with the natural course of the struggle, in such a way as to be of more benefit to the patient. The physician is no longer "a blind man with a club", trying separate combatants, and, as he vigorously takes part in the battle, now helping one side, and then the other.

The present knowledge of epithelial cell parasitism and phagocytosis should promptly be made the basis of experiment, as to the exact influence of each of the drugs and other agencies used in the treatment of conjunctivitis. This may be by the close observation of the microscopic changes occurring in the conjunctiva, following applications made to it; observations made on the lower animals in experimental conjunctivitis; or possibly by the laboratory study of isolated epithelial cells, placed under favorable conditions, as has proved a most fruitful method when applied to the study of blood cells. Simply to have this outline of the exact pathology of conjunctivitis in mind should enable us to watch its progress more intelligently. Some of the uncertainties regarding gonococcus conjunctivitis should be removed by examining the scrapings, instead of smears containing dead cells.

This new knowledge of inflammations of the conjunctiva points the way to advances in the understanding of inflammations of other mucous membranes. The more exposed of these should be found an inviting field for similar study. Even the intestinal canal, which is so accessible to the operator, should yield material for a more intelligent and exact knowledge of the relations of its flora to the cell processes of its mucous lining. Virchow had his attention turned to the importance of the cell in pathology by observing what happened in the cornea. Again eye lesions have furnished the opening paragraph in a new chapter in the natural history of disease.

E. J.

THE LONDON MEETING.

Those who are planning to go to the convention of English speaking ophthalmologic societies next July from America and the outlying countries of the British Empire should make their arrangements for the sea passage in the next few weeks, if they wish to do it with the greatest comfort at the time desired. Those who intend to offer papers to be presented there should now be working on them; and all, who are sufficiently interested to care for the Transactions of the Convention, might well send in the regis-

tration fee at this time. It is hoped that detailed official information as to how to do these things will be at hand for publication in the next issue.

VOLUME SEVEN.

The completion of seven annual volumes of this journal, continuing a name that came to it signifying previous good service in the realm of ophthalmology, makes it appropriate to consider what has been accomplished and what opportunities lie immediately before it. An occasional review of past progress is a stimulus to further advance; and suggestions of what more might be done would be gladly received from widely separated readers.

American ophthalmic journals, more than most others, have devoted a relatively large proportion of their space to keeping their readers informed of the progress of ophthalmology in other parts of the world. This was natural for a new country, that had to look to Europe for established institutions and centers of medical learning. But with some of the finest built, best equipped medical schools in the world and a developing devotion to training for the special departments of medicine, the time had come for America to produce medical journals that shall, in their respective fields, become leading medical journals of the world.

The American Medical Association, the strongest organization of physicians in the world, has done this for the general field of medicine and the general medical profession. Ophthalmology, best developed and most advanced of medical specialties, should do something of the same kind in its special field. The development of a world journal is one aim kept steadily in view, since the consolidation of the predecessors of this journal, seven years ago. What progress has been made in this direction?

A count of the original communications published in this volume shows they have been received from:

Canada	5
China	4
England	3
Austria	3
Hungary	3
Germany	3
Mexico	2
France	2
The Philippines	2
Hawaii	2
Denmark	1
South Africa	1

More than twenty per cent of the original papers have come from outside the United States. London, Paris, Vienna, Budapest, Berlin, Montreal and Peking have all been represented. To books noticed and society proceedings, every quarter of the globe has contributed; and "Current Literature" contains the most up-to-date and complete list of references to the current ophthalmic literature of the world that is published in any language.

The Ophthalmic Year Book has given during all this period the best review of the literature of ophthalmology, that has appeared for each year in a single volume. The German "Jahresbericht", suspended during the war for some years, is now dependent for completeness on the "Centralblatt" with which it is associated and to which it is largely an index and a key.

But in the matter of extended abstracts of the more important papers published in other languages, this journal has not rendered its readers the full service to be desired. This has not been the fault of the collaborators, in charge of the department or furnishing the abstracts that have been published. But it has simply been due to the expense of the added pages, that would have been needed to publish the additional abstracts or translations. It has been felt that the money at our command was better expended on other departments of the JOURNAL.

There has also been similar limitation in the original articles recently accepted for publication. We have tried to choose the best for our readers, altho no reader would be likely to agree wholly with the selections made. But among the papers declined, were some that contained matter of real value; only the space taken for its presentation would have been out of proportion to that available. Altho six years have elapsed since the war,

there has been, during that time, no material reduction in the costs of paper and printing. The only hope seems to be in further increase in the number of our subscribers.

In America there are as many who are not subscribers to this JOURNAL, who ought to take it for their own good and that of their patients, as there are who now take it. If every present subscriber would try to get one other, even tho many failed in the attempt, the immediate obstacle to great improvement in our JOURNAL would be overcome; and those who made the effort would at once share in the benefit. We will not give up sound financial conservatism, on which depends the permanence of this journal, to meet what seem to be immediate needs for progress; but we do desire to go forward, and to see some things done that have only been dreamed of. Sometimes you hesitate to solicit your immediate neighbors and rivals; but you know other ophthalmologists living elsewhere whom you might easily get to subscribe to the JOURNAL. If you will send us a list of such names, we will indicate which are, and which are not subscribers. Then you can write, urging the matter on their attention. The time to do this is NOW.

E. J.

BOOK NOTICES.

Section on Ophthalmology, American Medical Association, Transactions, 1924. Cloth, 356 pages, 66 illustrations. Chicago, A. M. A. Press.

This volume is noticeable in the series to which it belongs for its early appearance; having been received four months after the adjournment of the meeting, the transactions of which it records. The Secretary of the Section and the management of the A. M. A. publication office, are to be congratulated on getting minutes, papers, discussions and reports into the hands of readers, before the interest in the meeting has been eclipsed by subsequent events.

The policy has been adopted of having the sessions of this Section alternate with those of the Section on Laryngology, Otology and Rhinology; one meeting in the morning, the other in the afternoon, so that members can attend both. This plan has been very satisfactory to the bulk of members, who are interested in both specialties. Those who are not interested in both can attend other sections, in which they are more interested. It is not so popular with those who would like to read papers before the sections, because it restricts the number of papers that can be presented at any meeting; and compels some who would be contributors to the program to seek other means of publication.

This volume contains nineteen papers representing the work of twenty-five authors, six being of joint authorship. But there were also reports from six committees, having a membership of twenty. There were four members who demonstrated instruments and specimens; and every paper was discussed, giving free opportunity for each member to participate in the proceedings, an opportunity of which sixty-two different individuals availed themselves. Probably more than one-fourth of all who attended the sessions were heard upon some subject claiming its attention. This is a very good showing of general interest in the matters to which they were devoted.

Among the papers presented were four relating to tumors and their treatment by radiotherapy. The toxemias of pregnancy in their ophthalmic relations, and retinal hemorrhages in the newborn claimed attention. Hyperglycemia and cataract is a very live subject, of wide general interest. A very practical service to the ophthalmologists of America is rendered by bringing to their attention, what has been done with "telescopic spectacles" and magnifiers, to aid patients with poor vision. The paper on this subject occupies thirty-three pages, is well illustrated, and is reenforced by reports of sixteen cases in which such aid was rendered.

The address of the Chairman deals with important questions of professional ethics, particularly abuses with

regard to the selling of spectacles and the need for reliable opticians. Resolutions were adopted deprecating the selling of glasses by ophthalmologists where good opticians were accessible. The report of the Committe on Local Anesthesia contains much that should be accessible to everyone using local anesthetics in ophthalmic work.

After a discussion and report of a committee on the subject, the Section adopted resolutions, here included, suggesting the assistance of a medical advisory committee to cooperate with the Indian Bureau, in its efforts to reduce the prevalence of trachoma among the Indian tribes. E. J.

Transactions of the Luzerne County Medical Society for 1922 and 1923. Vol. 23. Paper, 8 vo., 214 pages. Wilkesbarre, Pa.

This volume is of interest to ophthalmologists largely because it represents the avocation of one of their number, Dr. Lewis H. Taylor, of the Publishing Committee, who also has done most to build up the library of this Society—a good medical library apart from any medical school in a city of less than 100,000 inhabitants. This volume contains but one paper devoted to ophthalmology. It reports three cases of orbital cellulitis seen in the service of Wills Eye Hospital of Philadelphia. Two of them were fatal.

E. J.

CORRESPONDENCE.

Ophthalmology in Scandinavia.

To the Editor:

During the month of August, this year, the writer had the privilege of visiting the Scandinavian countries with the object of observing the work done there in the field of ophthalmology. It was not a suitable time of the year, for the medical schools were closed, a great many of the men were away on vacations, and the clinics were less patronized than at other seasons. In spite of this, a good general idea of the activities in ophthalmology was obtained.

In general, it can be said of the clinics, that they are very well conducted; and of the hospitals, that they are spotless, well built, and, at least those erected recently, thoroly modern and attractive. This is particularly true true of the hospitals of Copenhagen, the first of the capitals visited. Here there are two hospitals erected within the last twenty years, both built in the pavilion style, with large open courts ornamented with flowers and trees. The buildings have a uniform architecture thruout, and the institutions as a whole are exceedingly attractive. The largest and latest of these is the Bispebjaerg hospital; and the other, the Rigshospitalet, which, as the name implies, is supported by the State of Denmark, and is under the control of the Medical School of Copenhagen. The first, unfortunately, has no separate department of ophthalmology, but in the Rigshospitalet there is a splendidly organized clinic under the venerable Prof. M. Tscherning, who has done so much work and written a great deal along the line of physiologic optics. His laboratories where he now devotes his entire time to research were visited. In his clinic, Dr. Olaf Blegvad is continuing his work on xerophthalmia and Dr. H. Moller on problems of vision in reduced intensity of light. At the Kummunehospitalet, a city hospital of Copenhagen, was found a well arranged eye department under Dr. Bentzen. The buildings, altho erected about sixty years ago, have lent themselves very well to modernization. A rather unusual procedure, later observed also in Kristiania, Norway, was the practice of sterilizing eye instruments by dry heat at a temperature of 150 C. (302 F.). The advantages claimed were that the instruments were not affected at all by the process.

A great deal of eye work is being done in Sweden, but unfortunately the opportunities of observing it did not happen to be so favorable, mostly due to the fault of the writer. There are three medical schools in Sweden located at Lund, Stockholm and Uppsala, respectively. Lund was not visited at all. In Stockholm a very

fine eye clinic was found at Serafimlasarettet under the charge of Prof. A. Dahlen, of Karolinska Institutet; another at the Sabbatsberg Sjukhus under Dr. E. Forsmark. The Gullstrand instruments were in evidence; a slit lamp was seen here which was equipped with an arc light, designed to be used also for treatment of inflammatory eye conditions. In the old university town of Uppsala are located the laboratories of Prof. A. Gullstrand, so well known among us as the designer of the instruments which bear his name. Prof. J. W. Nordenson, also well known to Americans, is at the head of the department of ophthalmology of the university. The Gullstrand instruments are naturally much used; they are here all equipped with the pointolite lamps, instead of the usual nitra bulbs. There was seen here also, the instrument designed by Lindgren for measuring accurately the depth of the anterior chamber. An instrument somewhat different, by Reder, is also to be found in Prof. Hagen's clinic in Kristiania.

Ophthalmology in Norway is centered in the University of Kristiania and eye clinic of the Rikshospitalet, under Prof. Sigurd Hagen. The Rikshospitalet is an institution about a hundred years old, which during the last decades, has enjoyed a rapid expansion and improvement. Much work is being done along the line of glaucoma: The genial Dr. H. J. Schiötz, the father of tonometry, was visited. He has just finished his final model of the tonometer and has rechecked his measurement curves. Operation procedures are being developed by Prof. Hagen and Dr. S. Holth, the latter working on a series of cases with his tangential sclerectomy, the final results of which are likely to be published soon. Dr. Borthen in Bergen is using iridotasis.

Contributions in the field of color sense are being made by several men: Hagen, Gjessing in Drammen, Ingolf Schiötz, the last named following out a line of investigation of color blindness, especially in its relation to heredity. Gjessing has also made a very complete study of the frequency of opacities of the lens in different ages. A practice which is a wide departure from the usual was observed in the Rikshospitalet: no bandages of any kind were applied after eye operations. For protection against injury a perforated metal shield, held by strips of adhesive, was placed over the operated eye, and nothing else. No bad results seemed to follow this procedure.

A trip thru the Scandinavian countries in the interests of ophthalmology proved well worth while and the uniform consideration and courtesy with which a stranger was received made it very pleasant as well.

D. L. Tilderquist,
Duluth, Minn.

Equal Ametropia in Twins

To the Editor:

I can add to the two recent cases mentioned in your Correspondence with "Equal Ametropia in Twins;" two nurses of my acquaintance, Bertha and Elsie H. My records show as follows:

Bertha on Jan. 8, 1918, under homatropin, read,
D. 20/15 with—1.00 S.⌒—1.00 Cyl. 95°
S. 20/15 with—1.00 S.⌒—1.00 Cyl. 85°

Elsie on Nov. 8, 1917, under homatropin, read,
D. 20/15 with—1.00 S.⌒—0.75 at 90°
S. 20/15 with—1.00 S.⌒—0.75 at 90°

On April 9, 1920, Elsie read, under homatropin,
D. 20/15 with—1.00 S.⌒—1.00 Cyl. 95°
S. 20/15 with—1.00 S.⌒—0.75 Cyl. 75°

On Oct. 9, 1923, Elsie read,
D. 20/15 with—1.25S.⌒—0.75 Cyl. 100°
S. 20/15 with—1.25S.⌒—0.75 Cyl. 80°

These patients tell me that they can wear each others glasses without discomfort and only their most intimate friends can tell them apart when they are dressed alike.

Linn Emerson,
Orange, New Jersey.

Physicians in the Rhineland

To the Editor:

In the March, 1924, (p.239) number of the American Journal of Ophtal-

MOLOGY, a letter from Professor Krückmann (Berlin) is published.

He says that himself and other doctors in Berlin knew nothing about a statement of the German medical practitioners, after the Ruhr occupation, deciding to refuse medical assistance to Frenchmen and Belgians. He goes on saying that, according to the enquiries he made, if such decisions were taken in a few places of Rhineland, they were not practically applied.

Certainly Prof. Krückmann's enquiry was an incomplete one. The collective decision of the German doctors was published, or spoken about, in the German medical and political papers; and we think that it escaped but few German doctors.

Professor Krückmann's letter thus denies the information mentioned, over and above, by "la Société Francaise d'Ophtalmologie". It was given as an example of the attitude of the German medical corporation; we are obliged to point out original trustworthy papers.

First of all, the great medical journal "Münchener medizinische Wochenschrift", February 16, 1923, has published a paper from Munich, February 14, 1923, in which it is said:

"The German doctors have placed themselves too on the lines facing the disturbers of peace. Two great medical associations: the 'Aerzte Vereinbund' and the 'Hartmannbund' beg of the German doctors to act, on our side, against the French and Belgians, who have disobeyed the rules and laws of humanity in the struggle. *Let us refuse any kind of assistance to Frenchmen and Belgians. Neither advice, nor help before the occupied regions get free.*" . . . . With such enemies, no consideration; using all the weapons we have yet is a duty for every German.

Therefore we join our colleagues and we cry out: *"Neither advice nor help to a Frenchman or to a Belgian* as long as the invaders have not left the German land."

In a paper "Die Einheit des Wollens", published in the Vossische Zeitung, February 11, 1923, Mr. Georg Bernhard writes:

"The Aerztevereinbund and the Hartmannbund appeal to the doctors to refuse any help to Frenchmen and Belgians, as long as the territories are not free from occupation."

These statements are clear enough; we need not speak any more about the question. The discussion is over; our answer puts a stop to the quarrel.

LE COMITÉ DE LA SOCIÉTÉ FRANCAISE D'OPHTALMOLOGIE.

TABLE OF TANGENTS.

This table, mentioned on page 691, was inadvertently omitted from the September issue.

TABLE OF NATURAL TANGENTS, with radius 1, that are likely to be of value in perimetric work. Tangents of intermediate angles can be interpolated, with sufficient accuracy for practical purposes.

Angle	Tangent Value
1 minute	.000291
2 minutes	.000582
3 "	.000873
4 "	.001164
5 "	.001454
10 "	.002909
20 "	.005818
30 "	.008727
40 "	.011636
50 "	.014545
1 degree	.01746
2 degrees	.03492
3 "	.05241
4 "	.06993
5 "	.08749
10 "	.17633
15 "	.26795
20 "	.36397
25 "	.46631
30 "	.57735
35 "	.70021
40 "	.83910
45 "	1.00000
50 "	1.19175
55 "	1.42815
60 "	1.73205

NEWS ITEMS

Personals and items of interest should be sent to Dr. Melville Black, 424 Metropolitan Building, Denver, Colorado. They should be sent in by the 25th of the month. The following gentlemen have consented to supply news from their respective sections: Dr. Edmond E. Blaauw, Buffalo; Dr. H. Alexander Brown, San Francisco; Dr. V. A. Chapman, Milwaukee; Dr. Robert Fagin, Memphis; Dr. M. Feingold, New Orleans; Dr. Wm. F. Hardy, St. Louis; Dr. Geo. F. Keiper, LaFayette, Indiana; Dr. George H. Kress, Los Angeles; Dr. W. H. Lowell, Boston; Dr. Pacheco Luna, Guatemala City, Central America; Dr. Wm. R. Murray, Minneapolis; Dr. G. Oram Ring, Philadelphia; Dr. Chas. P. Small, Chicago; Dr. John E. Virden, New York City; Dr. John O. McReynolds, Dallas, Texas; Dr. Edward F. Parker, Charleston, S. C.; Dr. Joseph L. McCool, Portland, Oregon; Dr. Richard C. Smith, Superior, Wis.; Dr. J. W. Kimberlin, Kansas City, Mo.; Dr. G. McD. Van Poole, Honolulu; Dr. E. B. Cayce, Nashville, Tenn.; Dr. Gaylord C. Hall, Louisville, Ky.; Dr. Edward D. LeCompte, Salt Lake City.

DEATHS.

Dr. Beudin of Brussels, died September 19th, aged 62 years.

Professor Daniel Van Duyse of Brussels, Belgium, died September 27th, 1924, at the age of 72 years, of angina pectoris.

SOCIETIES.

The Chicago Ophthalmological Society begins the twenty-first year of its activity with the October meeting. The membership of the society consists of one hundred and sixty-six active, four nonactive and ten honorary members.

At the October meeting of the Ophthalmological Section of the College of Physicians of Philadelphia, Dr. Henry Friedenwald of Baltimore, visited the section and read a paper upon "Vascular Lesions of the Retina in Young Persons." The remaining program was Dr. William Zentmayer, "Obstruction of the Central Artery of the Retina During the Performance of an Intranasal Operation"; Drs. Sigmund S. Greenbaum and Malcolm Harkins, "Experimental Herpetic Keratoconjunctivitis" with demonstration of microscopic and macroscopic specimens.

The following has been extracted from the October issue of the British Journal of Ophthalmology relative to the convention of the English speaking ophthalmologic societies: This convention will be inaugurated by a reception to be given by the President and Council of the Royal College of Surgeons on the evening of July 13th, 1925, at their house in Lincoln's Inn Fields. Four mornings, two afternoons and one evening will be devoted to the scientific work of the convention. One afternoon will be set apart for visits to institutions of ophthalmic interest in or about London. A banquet, a garden party, other receptions and excursions are also being arranged. The registration fee for those who are not members of the Ophthalmological Society of the United Kingdom will be £2, and for ladies accompanying members of the convention who wish to become associate members, 10s.

At the meeting of the Section on Ophthalmology of the New York Academy of Medicine, October 20, 1924, papers were read by Dr. Alex. Duane, on "Diplopia Observed in Various Types of Paralysis," with a lantern slide demonstration; by Dr. M. Uribe Troncoso on "Gonioscopy; Its Clinical Application"; with a lantern slide demonstration. A general discussion followed.

PERSONALS.

Dr. William Campbell Posey of Philadelphia has returned from his summer home at Watch Hill, Rhode Island.

Dr. Joseph L. Goodwin, formerly of the Trachoma Hospital, Russellville, Arkansas, has been sent to Eveleth, Minnesota, to establish a trachoma hospital there.

Dr. Robert Fagin has removed his offices to Suite 1430 Exchange Building, Memphis, Tenn. He is limiting his practice to diseases of the eye.

Dr. and Mrs. William Sweet of Philadelphia, have returned from a summer abroad. They visited Vienna and later spent several weeks, as is their custom, at Aix-le-Bains.

Dr. Howard F. Hansell of Philadelphia, spent the month of June motoring in England. Dr. and Mrs. Hansell spent the remainder of the summer on the Continent mainly at Vittel, France.

Dr. A. F. MacCallan has been elected Assistant Ophthalmic Surgeon to the Westminster Hospital, London. Dr. MacCallan has returned to England to practice ophthalmology after an absence of twenty years.

At a recent meeting of the Board of Regents of the University of Nebraska, Dr. Harold Gifford was made emeritus professor of ophthalmology and Dr. Jas. Patton was appointed professor of ophthalmology and chairman of the department.

Dr. and Mrs. Sidney Newcomer (both ophthalmologists) are completing their studies in Europe by a sojourn in Upsala, Sweden, where Dr. Newcomer is studying physiologic optics under the supervision of Dr. Allvar Gullstrand.

Dr. Luther Peter of Philadelphia, Professor of Ophthalmology at the Temple University, spent July in Vienna. While visiting the General Hospital he devoted special attention to the subject of Red Free Light and to some special studies in Histopathology. Dr. and Mrs. Peter later visited Switzerland for the month of August.

Dr. Luther C. Peter gave a group of Philadelphia ophthalmologists the pleasure of meeting Lieutenant-Colonel Kirkpatrick of London at luncheon at the Union League, late in September. Lieut.-Col. Kirkpatrick was the honor

guest of the American Academy of Ophthalmology and Oto-Laryngology at its recent session in Montreal, where he presented a paper upon the subject of "Some Aspects of Primary Cataracts."

Dr. and Mrs. Casey A. Wood accompanied by Dr. George H. Simmons, of the Journal of the A. M. A., and his niece, will sail on November 14th, for India. After spending several weeks in the Northern Provinces, the party will travel to Ceylon by way of Calcutta and Madras, eventually settling in Colomba for the winter and spring. Dr. Wood continues to collect material and to make field notes for his proposed work on the eyes and eyesight of birds.

Dr. William Zentmayer of Philadelphia, Professor of Ophthalmology in the Post Graduate School of the University of Pennsylvania has returned from a visit to Europe. He spent several weeks in the department of ophthalmology of the University of Bern in association with Dr. Heinrich Streuli in the investigation of clinical cases with the Gullstrand slit lamp microscope. Dr. G. Oram Ring of Philadelphia joined Dr. Zentmayer at the University of Bern and both have returned greatly impressed with the importance of the slit lamp work and enthusiastic concerning the facilities of the Bern clinic, over which Dr. Streuli so ably presides. Dr. and Mrs. Ring after leaving Switzerland motored over the French Alps and later spent two weeks in a motor trip along the French and Ligurian Riviera, sailing from Genoa for America early in September.

MISCELLANEOUS.

Under the will of Edward A. LaRose, $2,000 was left to the Louisiana Commission for the Blind.

Erection has begun of the new Industrial Home for the Blind at 516 Gates avenue, Brooklyn. The estimated cost of the completed structure is $350,000.

The New York Commission for the Blind reports that it has completed a census of blind persons in the state. There is a total of 8,001 and 3,728 of these are residents of New York City.

Drs. John H. Burleson, Thos. J. Walthall, Oscar H. Judkins, James S. Steele and Archibald F. Clark, San Antonio, Texas, have purchased the old Hugo homestead on Main avenue and will turn it into an eye, ear, nose and throat hospital.

The Eyesight Conservation Council estimates that defective vision afflicts 25,000,000 of the 42,000,000 persons in gainful occupations. The increase of blindness and lesser troubles has become so alarming in the last decade that the nation is confronted with a menace of great magnitude.

The New York State Commission for the Blind states that its census shows 8,001 blind persons in the state, of whom 3,728 live in New York City. The commission also states that the number of persons with serious visual defects is much larger than the number who are blind.

On October first the laying of the corner stone of the Todd Memorial Hospital was celebrated in Minneapolis. When completed this institution will contain fifty beds for the accommodation of eye, ear, nose and throat patients. It is erected in honor of Dr. F. C. Todd, former Professor of Ophthalmology and Oto-laryngology.

The Medical College of the State of South Carolina, Charleston, South Carolina, celebrates the one hundredth year of its existence, November 12-13, 1924. Eye, Ear, Nose and Throat Clinics will be a feature of the exercises commemorating the Centennial. Alumni and distinguished guests will be present.

Some of the causes of 279 serious eye accidents, reported to the National Committee for the Prevention of Blindness, during one month, are: The explosion of a pipe into which a cartridge had found its way with the tobacco; a wound from the fin of a fish; an eyeshade catching fire; a peck from a pet rooster; a jab in the eye from the horn of a cow.

About fifty ophthalmologists from all over the world attended Professor Vogt's course on the Slit Lamp, during the first week of September, at Zurich, Switzerland. Von der Heydt and Wilder of Chicago, Wilmer of Washington, Beeman of Grand Rapids and Clapp of Baltimore were a part of the American contingent.

More than 35,000 boys and girls, pupils in Chicago's public, private and parochial schools, have enrolled in an international campaign to reduce defective vision. The purpose of the contest, which is under the direction of the electrical industry in the United States and Canada, is to induce the children to study proper lighting, so that in future years there will be less eye trouble.

The Missouri State Board of Health and the U. S. Public Health Service are cooperating in conducting a trachoma clinic in Missouri. The last one was held at Gallatin, October 29-30. The Wabash Railroad furnishes and transports a fully equipped car free of charge. Dr. R. L. Russell, director of the division for prevention of blindness, State Board of Health, and Dr. John McMullen, of the U. S. Public Health Service, are in charge of the work.

The campaign started by the Secretary of the Interior to eradicate trachoma among the Indians shows that on the Navajo Reservation in Arizona and New Mexico 6,274 Indians were examined, 1,354 of whom had trachoma. 1,084 trachoma operations were performed. 1,638 Indians were hospitalized. Clinics were held at two places on the Hopi Reservation where 740 Indians were examined, 209 found to have trachoma, and 152 trachoma operations performed. The campaign was started July first under the direction of a special physician of the Indian Bureau, assisted by surgeons of the U. S. Public Health Service. Three operating field units were sent out to cover the Navajo, Hopi and other Indian reservations in the Southwest. Each unit was headed by a special physician, nurses and had the necessary medical supplies.

Current Literature

These are the titles of papers bearing on ophthalmology. They are given in English, some modified to indicate more clearly their subjects. They are grouped under appropriate heads, and in each group arranged alphabetically, usually by the author's name in **heavy-faced type.** The abbreviations mean: (Ill.) illustrated; (Pl.) plates; (Col. Pl.) colored plates. Abst. shows it is in an abstract of the original article. (Bibl.) means bibliography and (Dis.) discussion published with a paper. Under repeated titles are given additional references to papers already noticed. To secure early mention, copies of papers or reprints should be sent to American Journal of Ophthalmology, 217 Imperial Building, Denver, Colorado.

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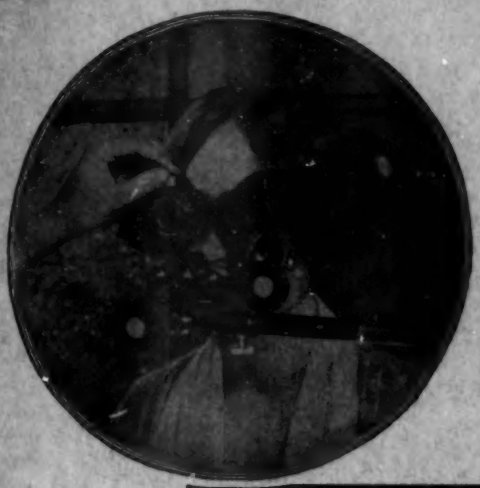

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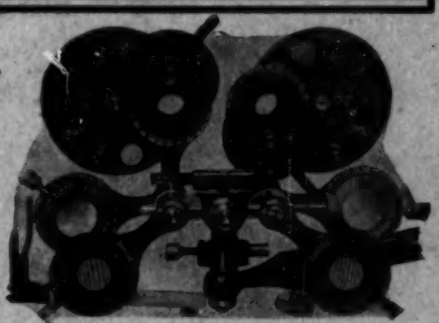

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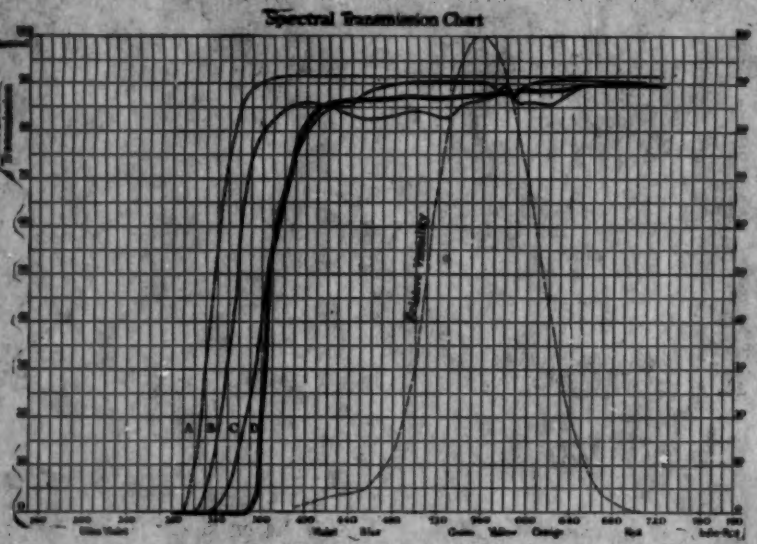

(A)—White Crown Glass Bureau of Standards Circular 119.
(B)—Absorption glass measured by Wellsworth Laboratories.
(C)—Manufacturers published chart as B. S. 40221.
(D)—Cruxite measured by Bureau of Standards.

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